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EPONYMS.

BY SIR D'ARCY POWER, K.B.E., LONDON.

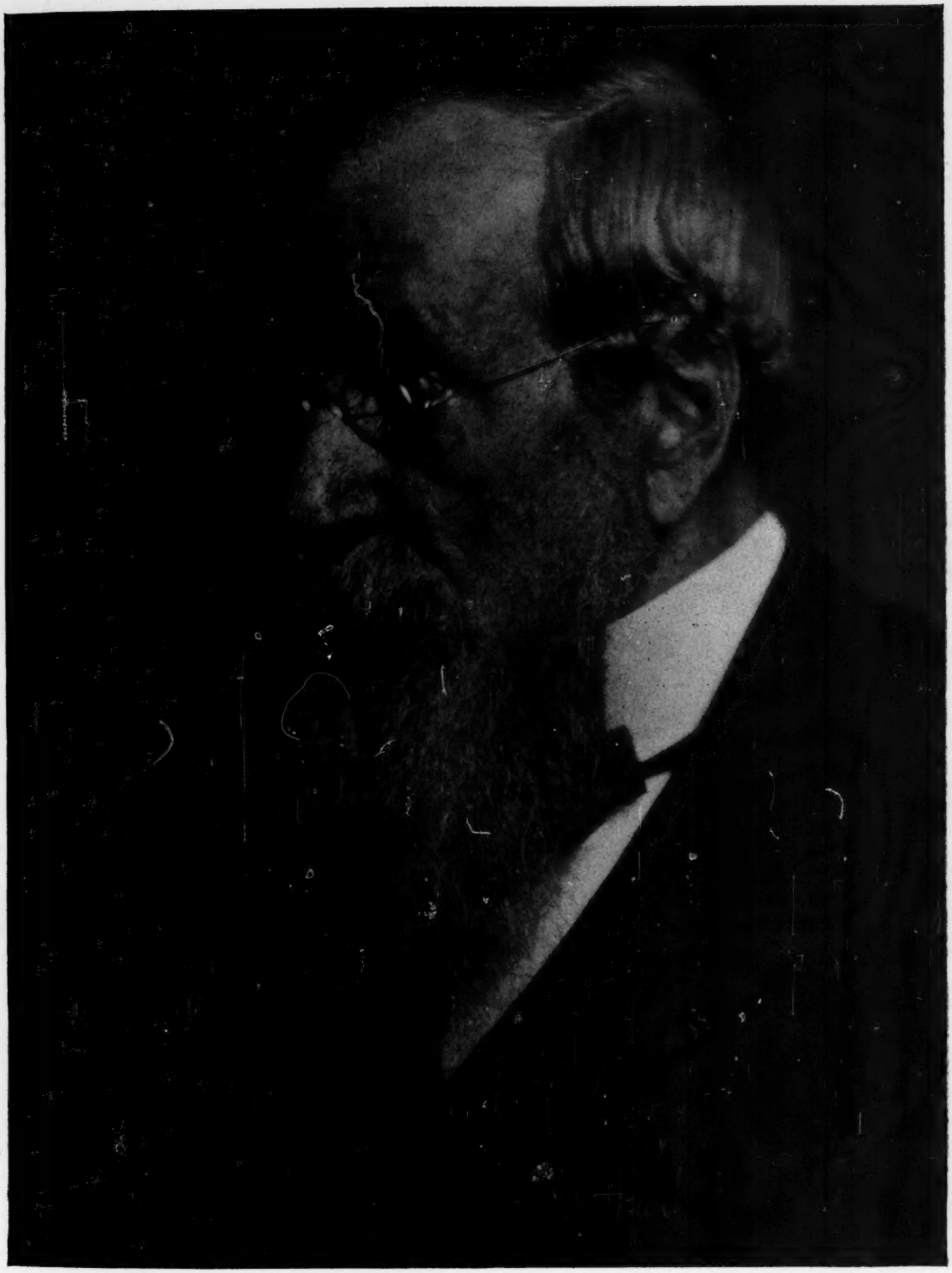
XXI. HUTCHINSON'S TRIAD.

JONATHAN HUTCHINSON, the second of the eight sons of Jonathan Hutchinson and Elizabeth Massey, his wife, was born at Selby, near York, where his father was a prosperous "middleman in the flax trade", on July 23, 1828. He came of a Quaker stock which had farmed a small estate at Gedney, in the flat lands near Boston, in Lincolnshire, and both his parents were subscribing members of the Society of Friends. Jonathan, in accordance with the practice of the Friends, was educated at home, and it was not until he was 17 that he was apprenticed to Caleb Williams, a Quaker doctor and minister, who had one of the largest practices in York. Eighteen months later he entered the small school of medicine which maintained a precarious existence at York, and where his master lectured on materia medica and therapeutics. Here he came under the influence of Dr. Thomas Laycock, who was also a teacher in the school, and was afterwards Professor of Medicine in the University of Edinburgh. Laycock, perhaps, first drew his attention to the influence of heredity in disease, a subject to which Hutchinson afterwards devoted so much attention. In 1849, the last year of his apprenticeship, he came to London for clinical instruction, as was then the custom, entered at St. Bartholomew's Hospital, and worked in the out-patient room under Paget and in the wards as dresser to Mr. Thomas Wormald. The hospital records make no mention of his holding any post on the junior staff, but that his career was somewhat out of the ordinary is shown by his election as President of the Abernethian Society, the students' debating society, where the officers are chosen by the votes of their contemporaries. He was admitted a Member of the Royal College of Surgeons of England in 1850, having previously obtained the Licence of the Society of Apothecaries. He returned to York immediately to act as House Surgeon at the County Hospital. He came back to London on the expiration of his term of office, and was appointed physician's assistant at the Hospital for Diseases of the Chest, which was then situated in Liverpool Street.

It seems to have been in his mind for a short time to go abroad as a medical missionary, and to this end he devoted himself to gain a sound knowledge of diseases of the eye and the skin by attending the practice of the hospitals at Moorfields and Blackfriars which are devoted to these specialties. During this period, says Sir Rickman Godlee, "he practised a Spartan economy in order to save his father expense, and satisfied himself that the cheapest way of supporting life was a diet of figs and bread". At the same time he contributed weekly "reports from the hospitals" to the columns of the *Medical Times and Gazette*, for which no doubt he received small cheques from time to time. His plan of life seems to have been changed by his election as Surgeon to the Hospital for Diseases of the Skin and Surgeon to the Metropolitan (Free) Hospital, which was then situated in Devonshire Square. He lived for a time at Wallfield, Reigate, and had rooms in Finsbury Circus, in the heart of the City of London, where he had for neighbours members of the staffs of the London and Guy's Hospitals. His position had become assured by 1860, when he was appointed Assistant Surgeon to the London Hospital, for by this time he had made his name as an original observer with the papers on hereditary syphilis to which attention will presently be directed. He gave up his house at Reigate therefore and moved with his wife and his two children to 14, Finsbury Circus, where he lived for the next sixteen years, and built up a remarkable practice by which he supported his wife and the nine children she had borne him. He moved "with some hesitation", he says, to Cavendish Square in 1894, a statement which is amplified by Mrs. Hutchinson when writing to a daughter. She says, "Our going West is very doubtful, I think, after all. Sir James Paget tells papa he *must* go, and give up all hope there of teaching and advancing science, for it is time he attended to No. 1. He can do that there but nothing else. This quite scared papa, and I can't help smiling at how advice, which would attract most men, disgusts him, and he thinks he had better stop here. We have not quite decided yet".

He was elected a Fellow of the Royal College of Surgeons of England in 1862, and in the following year he was appointed Surgeon to Moorfields and Surgeon to the London Hospital, where he was assigned the special duty of lecturing on Diseases of the Eye. He filled, in due course, all the usual offices at the Royal College of Surgeons, was President in 1889 and Hunterian Orator in 1891. He was elected a Fellow of the Royal Society in 1882, had the honour of Knighthood conferred upon him in 1908, and died in 1913.

Sir Rickman Godlee describes him well when he says: "We recall him as a tallish, dark figure, that changed very little from middle life to old age; dark eyes that seemed to look past you through his spectacles; black hair, black beard, lengthening and growing grey with age; a suit of black broadcloth, and a top hat that grudgingly gave place to a wideawake. We see him presiding at our medical meetings and addressing them in precise clear-cut sentences, rather solemn, without much sparkle, but full of meat, and made attractive by more than a trace of Yorkshire accent." Such, indeed, was Hutchinson; a great teacher, an original thinker, a man of wide knowledge and very retentive memory, interested in many forms of education, general as well as professional. He taught not only by the spoken and



SIR JONATHAN HUTCHINSON

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written word, but by appeals to the eye. To this end he issued many parts of a vast atlas of diseases of the skin, and wherever possible he illustrated his observations by drawings, photographs, and coloured plates. At Haslemere, where he lived in later life, and at Selby, his birthplace, he established small but carefully selected museums to elucidate the geology, history, and geography of the neighbourhood. It was one of his special pleasures to explain these collections to small parties of visitors gathered from all ranks of society.

For many years he edited *The Archives of Surgery*, and he was the mainstay of the New Sydenham Society, which issued a series of useful translations of French and German works for the benefit of those medical men who only knew English.

Post-graduate teaching made an especial appeal to him, and he was instrumental in founding and carrying on the work of the Policlinic or Medical Graduates' College in Chenies Street. Throughout his life he showed the thoroughness and tenacity of purpose which was inherited from his Quaker forbears. He maintained that leprosy was due to a fish diet, and travelled widely to secure proofs in support of his hypothesis. He did much to revolutionize the treatment of syphilis in this country, for he taught that the disease should be treated, and not merely the symptoms as was then the usual practice. He was fortunate in living to see the discovery of the agent causing this disease in which he had been interested during his whole working life. He died at his house The Library, Inval, Haslemere, on June 23, 1913.

The foundation of Hutchinson's triad or the tripod he built to support the diagnosis of hereditary syphilis was laid whilst he was still a student. The building was in process of erection for ten years, and was completed in 1861. The successive stories were : inflammation of the eyes ; malformations of the teeth ; deafness.

EYES.

Hutchinson came from York, entered at St. Bartholomew's Hospital, and served as dresser to Mr. Thomas Wormald. Whilst acting in this capacity his attention seems to have been drawn to two patients suffering from a chronic inflammation of the eyes which had long been known to ophthalmic surgeons as 'scrofulous corneitis'.

The first patient was " Mary D., aged 8, Irish. Of this case I have no further notes than that the nose was destroyed, level with the face, by phagedenic ulceration ; that the soft palate was also destroyed ; and, further, that both eyes were affected by kerato-iritis in a severe form. The child came under my observation in St. Bartholomew's Hospital. I considered the case to be one of hereditary syphilis, and Mr. Wormald, under whose care the child was, agreed in the opinion.*

The second patient was " Annie M'Q., aged 14, who came under my observation when she was a patient at St. Bartholomew's Hospital under the

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* *Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital*, 1859–60, ii, 76, *Case* 42. Published again in *A Clinical Memoir on Certain Diseases of the Eye and Ear consequent on Inherited Syphilis*, London, 1863, p. 63, *Case* 42.

care of Mr. Wormald, by whom the syphilitic nature of her symptoms had been fully recognized. She was a puny child of most characteristic aspect. There were nodes on both tibiæ and puckered cicatrices at the angles of the mouth. She was an only child and an orphan, and no history of her infancy was obtainable. About three years ago one of the nodes in the tibia ulcerated, and a piece of bone came away. Nearly at the same time her left eye inflamed, and continued so a long time. The sight was attacked for the first time only three months ago. Much pain in the orbits had attended the attack.

"At the time I saw her, three years after the outbreak of the disease, both irides were thin and mottled in colour; the pupils were adherent and irregular, and the corneæ opaque in their deeper layers. The eyes appeared to be permanently damaged."*

Hutchinson was 21 years of age at the time that these two notes were taken. He worked by the light of them first as Assistant Surgeon at the Metropolitan Hospital, then as a member of the staff of the Royal London Ophthalmic Hospital in Moorfields, and afterwards as Assistant Surgeon to the London Hospital, until he had collected details of sixty-four similar cases. These he published in the first and second volumes of the *Ophthalmic Hospital Reports*, where there is a note that the paper was received on Oct. 18, 1858, and by this time he had given the name of 'chronic interstitial keratitis' to the disease, and the older term 'scrofulous corneitis' was no more heard of. In this paper he gave the following reasons for believing that the disease was the direct result of inherited syphilis:—

"1st. From its being a very well-marked and peculiar form of disease, it is *a priori* probable that it acknowledges some single and definite cause.

"2nd. Its subjects are almost invariably of very peculiar physiognomy, and usually bear the most marked similarity to one another.

"3rd. Its subjects almost invariably have their upper central incisor-teeth of the permanent set dwarfed and notched in a peculiar and characteristic manner.

"4th. In most cases the features alluded to under the last two heads bear no resemblance whatever to those of 'struma' properly so called. The subjects of true struma, on the contrary, usually have large white teeth, and are often of florid complexions.

"5th. I have not yet seen a single case in which the patient was the subject of phthisis, and very few in which enlargement of the glands of the neck had occurred.

"6th. It affects by preference the eldest living child of the family, a circumstance to be expected under the syphilitic hypothesis, but wholly inexplicable under that of struma.

"7th. It affects female children in preference to males, and occurs in families in which a large infantile mortality has usually occurred.

"8th. It occurs in all classes of the community, the well-fed and under-fed, and the residents in the most healthy situations (seaside, etc.), as well as those of crowded cities.

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* Op. cit., 76 and 63, *Case* 43.

" 9th. In nineteen out of thirty-one cases in which I was able to make inquiries on the subject, I obtained a confession that one or other parent had suffered from constitutional syphilis prior to the birth of the patient.

" 10th. In thirty-two cases out of thirty-eight in which I obtained information as to the health of the patient during early childhood, a clear history of the usual symptoms of infantile syphilis was given.

" 11th. In eleven instances there was a clear history of symptoms of infantile syphilis having been observed in brothers or sisters of the patient.

" 12th Whilst, as above observed, enlargements of the lymphatic glands (two cases) are unusual, other affections far more closely connected with syphilis than with true struma, such as nodes (six cases), ulceration of the palate (six cases), and erosive lupus (three cases) are not infrequent in the subjects of this disease."*

By such results from very small beginnings Hutchinson merited the noble eulogium passed upon him by Sir James Paget many years afterwards, when he said : " I venture to make myself proud in calling him one of my pupils. Not my pupil in syphilis ; with regard to which I say nothing, but that, at least, I did not interfere with his studies while he pursued them with myself in the out-patients' room of St. Bartholomew's Hospital, where I saw nothing but confusion, and he saw light coming. And I venture to say, if any of us think that in this instance Mr. Hutchinson is looking into outer darkness we shall be very unwise if we neglect his signals when he says that light is come." †

TEETH.

One of the earliest references to what afterwards became known as " Hutchinson's teeth " is contained in a " Report on the Effects of Infantile Syphilis in Marring the Development of the Teeth ".‡ Hutchinson says in this report that " for a considerable time past I have been in the habit of recognizing in a certain very peculiar development of the permanent teeth that their possessor had in infancy suffered from hereditary syphilis. A remark to this effect, which I made at a meeting of the Pathological Society early in its past session, being received with expressions of incredulity, it occurred to me that it might be well to make public such evidence as I possessed on the subject." He then proceeded to show casts made by Mr. Alfred Coleman, who was acting as Dentist at the Metropolitan Free Hospital. The cases were thirteen in number taken from patients who were attending the Royal Ophthalmic Hospital at Moorfields for the treatment of chronic interstitial keratitis, an affection, he goes on to say, " which is, I believe, almost always a result of inherited syphilis. Their ages varied from twenty-eight years to five years. In all a clear history of syphilis was established, whether by the free confession of the patient's parents, or by the account given of symptoms of undoubted character during infancy."

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* *Ophthalmic Hospital Reports*, 1859–60, ii, 103, 104.

† *Transactions of the Pathological Society*, 1876, xxvii, 373.

‡ *Ibid.*, 1858, ix, 449.

The report was considered sufficiently important to be referred, as was then the custom, to a Committee which, in this instance, consisted of Dr. Graily Hewitt, Physician to the Samaritan Free Hospital for Women and Children; Mr. Henry Lee, Surgeon to King's College and the Lock Hospitals; and Mr. Henry Thompson, then Assistant Surgeon to University College Hospital, who afterwards became well known as Sir Henry Thompson, the urinary surgeon who operated upon the Emperor Napoleon at Chislehurst. The Committee reported on July 14, 1858, that six cases had been examined whose teeth presented certain marked structural and other peculiarities. "The previous existence of syphilis was substantiated in five out of the six cases, and the sixth case was probably of the same character.

"The Committee are disposed to conclude that the relation of cause and effect sought to be made out by Mr. Hutchinson is sustained by a careful examination of the cases referred to, but they hesitate to express a more decided opinion on the number of cases submitted to them. Mr. Hutchinson desires to offer further cases for examination, and the Committee, feeling the importance of the subject, have determined to meet again, and obtain this additional evidence on the subject".*

In the following year Mr. Hutchinson presented a more elaborate and well illustrated paper to the Pathological Society. It was entitled "A Report on Malformations of the Teeth, as indicative of Diathesis",† and is dated Jan. 18, 1859. He summarizes his conclusions in the following words after a consideration of more than seventy cases:—

"I believe that the peculiarities of dental malformation which I have described occur in subjects of hereditary syphilis:—

"1. Because, in cases of interstitial keratitis, a disease which I have elsewhere endeavoured to prove to be of hereditary syphilitic origin, these peculiar teeth are almost invariably met with.

"2. Because I have hardly ever seen teeth of well-characterized syphilitic type, excepting in patients who either had keratitis at the time they were under observation, or had had it at some former one.

"3. Because these teeth are usually found coincident with the physiognomy of hereditary syphilis.

"4. Because in a large majority of cases where these teeth are seen, a clear history of infantile symptoms is obtainable.

"5. Because in not a few instances, the parents of children with these teeth have spontaneously informed me that they had suffered from syphilis prior to the child's birth, and that the latter had also been treated in infancy for the same.

"6. Because I have repeatedly seen these teeth in patients the known subjects of hereditary syphilis, but who had never taken mercury.

"7. Because I have often examined the teeth of those, not the subjects of syphilis, who in infancy had taken courses of mercury, without ever once finding the syphilitic type of teeth at all closely simulated.

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* *Transactions of the Pathological Society*, 1858, ix, 456.

† *Ibid.*, 1859, x, 287–299.

" 8. Because I have repeatedly ventured to pledge myself to a diagnosis of hereditary syphilis founded solely on the state of the teeth, and subsequently found that the patient's history placed the correctness of the opinion beyond a doubt.

" 9. Because the teeth described are not met with in subjects of any of the forms of struma, properly so-called. Thus the teeth of phthisis have long been known to be remarkable for their brilliant pearly-whiteness and fine form ; and out of thousands of cases of strumous varieties of ophthalmia (i.e., the ulcerative, pustular, etc., superficial and not interstitial), in which I have looked at the teeth, I have never once seen them of marked syphilitic type. A similar statement to the last I may also make as regards numerous cases of true glandular struma in which I have examined the teeth, and found them usually of large size and good form.

" 10. Because the same clinical evidence which has been satisfactory to myself has also proved convincing to many other much better observers, including the whole surgical staff of the Ophthalmic Hospital."

Here, as in the case of interstitial keratitis, Hutchinson's demonstration was so conclusive that the teeth gradually came to be accepted as a proof of hereditary syphilis.

DEAFNESS.

Mr. Jonathan Hutchinson, Assistant Surgeon to the London Hospital and Surgeon to the Metropolitan Free Hospital, in conjunction with J. Hughlings Jackson, M.D., Assistant Physician to the Metropolitan Free Hospital, both young Yorkshiremen, published a paper in the *Medical Times and Gazette* which appeared on Nov. 23, 1861.* It is a short report on " Cases of Deafness associated with Syphilis ", in which they state that " cases of deafness in association with congenital syphilis are not uncommon ; but here we are not able so distinctly to name the special structures attacked as in the case of syphilitic disease of the eye. Of one hundred cases of congenital syphilis collected by Mr. Hutchinson, ten were noted to have been deaf, and of these nine became deaf after otorrhœa ". The details of three cases are then given, but only one was definitely associated with hereditary syphilis. The patient was " Eliza T., aged 15, who was admitted under the care of Mr. Hutchinson, at the Metropolitan Free Hospital, on October 23 (1861 ?). The aspect of hereditary syphilis was well marked. Teeth typical. The irides were steel grey, pupils irregular, and the corneæ dim from an attack of kerato-iritis at the age of three years. For this attack she attended at Moorfields for one year, under the care of Mr. Critchett. She regained fair health, and was able to read easily. She had good hearing until about three years ago ; she had then some pain and much noise in the ear. The right ear began to fail first, but the other began soon after ; and in the course of a year she had complete loss of all hearing. There was at no time the least discharge, until the last few months, when a little watery fluid has run out. She is now quite deaf, and

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* *Medical Times and Gazette*, 1861, ii, 530.

can converse only by her fingers (the deaf and dumb alphabet). Since her deafness she has got to speak thickly and almost in a whisper. Her mother had had six children, of whom the patient is the youngest living. She (the patient) when an infant had a slight rash; when nine months' old she had for two months a fit of illness, but no special symptoms of it are recollected. Three brothers, older than the patient, are well, and have never ailed anything particular. Two girls, one born before Eliza and one after, died in infancy."

In the *Clinical Memoir*, referred to on page 3 (footnote), and elsewhere, Hutchinson demonstrated the following features of the deafness due to inherited syphilis :—

1. It is, like interstitial keratitis, a symmetrical disease, in the sense that both eyes or both ears are sooner or later affected.

2. It occurs about the same period of life—childhood or puberty. There are some exceptions to this rule.

3. It is much rarer than interstitial keratitis, and even more intractable to antisyphilitic treatment. A patient with keratitis, however severe, usually recovers a fair amount of vision; the deafness is as a rule both of high degree and permanent.

4. The pathology is unknown, but the internal ear is almost certainly the site of the lesion.

It is of interest to note that hardly anything has been added to our knowledge of these subjects since Hutchinson published his observations some sixty years ago. Many attempts were made to controvert them, but in no single point has their accuracy been disproved.

It was hoped that the introduction of salvarsan would materially shorten and assist the treatment of interstitial keratitis, etc.; unfortunately this hope has not been fulfilled.

It may be added that in the subjects of interstitial keratitis, etc., the persistence of a positive Wassermann reaction, in spite of treatment, is remarkable.

We are indebted to the courtesy of Jno. Hutchinson, F.R.C.S. Eng., Sir Jonathan's eldest son, for permission to reproduce the portrait of his father, and to Mr. Walter Bennington, Holborn Viaduct, for the photograph from which the illustration was made.

THE IMPORTANCE OF HÆMATOLOGY IN SURGERY.

By A. PINEY, London.

(Being two Arris and Gale Lectures delivered before the Royal College of Surgeons on February 17 and 19, 1926.)

The employment of the findings of morphological hæmatology in the routine investigation of clinical cases has been much neglected by the surgeon; even when such an examination has been carried out, the interpretation of the findings has presented much difficulty and has often been mistrusted. It is the purpose of the first part of this paper to show that some of the commonly accepted deductions need much modification before they can serve the purposes of the practitioner. An extreme degree of leucocytosis has often been noted in cases without suppuration, and, conversely, leucopenia has often been seen in cases in which operation has revealed the existence of a large collection of pus. It is such apparent contradictions between the clinical and hæmatological results which must necessarily shake the surgeon's trust in these laboratory methods of examination. I wish immediately to emphasize the fact that the size of a leucocytosis is not the feature on which most stress is to be laid, just as the size of a tumour can give little information as to its nature. The one method of real value must depend upon detailed examination of the constituent cells; this is admitted in regard to neoplasms, and here it is hoped to show that the same technique must be used in examination of the blood.

The subject presents many inherent difficulties, and these are in no way lessened by the existence of an enormous literature. I shall confine myself as far as possible to records of personal experience both in observation and in interpretation.

A very brief introductory account of the essential theoretical bases of hæmatology must precede the discussion of the surgical applications of the subject.

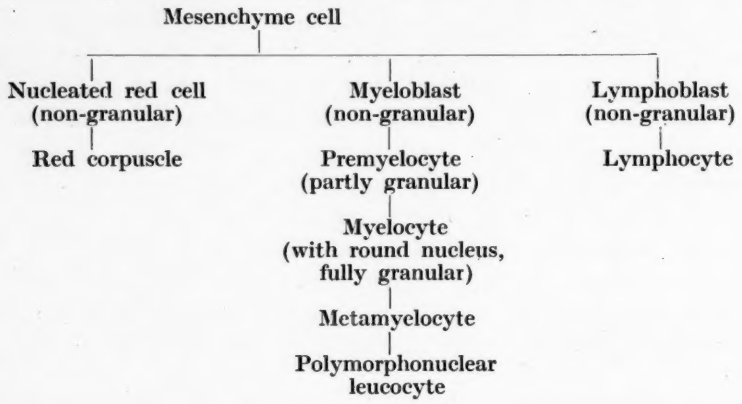
THE BLOOD-CELLS.

Examination of suitably stained films of blood shows the presence of red corpuscles, granular leucocytes, non-granular leucocytes (lymphocytes), and platelets. The red corpuscles and the granular leucocytes are formed in the bone-marrow, whereas lymphocytes are produced in lymphatic glands, spleen, and lymphoid tissue throughout the body. The schema given on the next page shows the genealogical tree of the blood-cells. A number of types are omitted for the sake of simplicity.

It will be noted that the original parent cell of the mature granular leucocytes (myeloblast) is non-granular, but there is now no doubt that most of the mature granulocytes in the blood are derived from myelocytes, i.e.,

from fully granular cells (Ellermann). It is clear from the chart that the cells with definitely lobulated nuclei (polymorphonuclear leucocytes) are more mature than those with a single round nucleus—a difference which is also shown by the greater density of the nuclei of the former. The intermediate stage in which the nucleus is bent but is not definitely lobulated is known as the metamyelocyte, which is often erroneously included with the polymorphonuclears. Arneth has appreciated these fine details very fully, and has contended that it is only a logical extension of this knowledge to regard a polymorphonuclear cell with a large number of lobes as being older than one with only two. He has supported this conception in numerous publications, and has attempted to show that normally a definite percentage of cells of each nuclear type, viz., 2-, 3-, 4-, and 5-lobed, is present in the blood. This teaching has been applied to all types of blood-cells, but most of the work has dealt with those elements containing neutrophilic granules. Arneth's

THE GENEALOGY OF THE BLOOD-CELLS.



method is very laborious and is subject to many fallacies; in addition there is the objection that the evidence that greater maturity is always expressed by greater complexity of the nuclear lobes is meagre.

It would seem obvious, however, that some simpler method based upon the facts known as to the maturation of myelocytes into polymorphonuclear leucocytes might be elaborated so as to serve the purpose of gaining a deeper insight into the finer biological processes at work in many infections. It is mainly to the work of von Schilling-Torgau that we owe an accurate method based on such considerations; it is a method sufficiently simple to be used even for routine examination. He has pointed out that it is possible and reasonably easy to distinguish the cells with neutrophilic granulations into several obvious groups, which certainly contain cells of different degrees of maturity, viz.: (1) Cells with completely round nuclei (myelocytes). (2) Cells with slight nuclear indentation, i.e., young metamyelocytes; he refers to these as 'Jugendformen' (young forms). (3) Cells in which there is no true nuclear lobulation, but in which the nucleus is arranged as a long, narrow, bent mass, i.e., ordinary metamyelocytes. These are cells to which he refers as 'Bandformen' and we may call band nuclei. (4) Cells with definite nuclear segmentation, i.e.,

typical polymorphonuclear leucocytes ; all these last are classed together. It is perfectly easy to note that, in normal blood, the cells with neutrophilic granulation and band nuclei always form about 4 per cent of the total leucocytes ; wide variations occur in pathological conditions, as will be pointed out later.

It is necessary to emphasize a few further facts before describing actual examples of hæmatological interpretations. The neutrophilic leucocytes form the usual cellular response to the great majority of infections, and are liable to suffer injury when exercising their defensive powers ; this change is seen in its most extreme degree in pus-cells. In blood the changes are less severe but require to be carefully noted. The alterations affect either the cytoplasm or the nucleus, but as a rule abnormalities can be seen in both constituents. Increased density of the nucleus (pyknosis), with loss of normal distinction of basi- and oxy-chromatin, clumping of cytoplasmic granules, or even their disappearance in places, are common, while vacuolation of the cytoplasm may occur in severe infections (*Fig.* 1). Changes of this type will obviously render it much more difficult or even impossible to determine accurately the number of nuclear lobes as required in Arneth's method, whereas it in no way decreases the value of the technique here recommended.

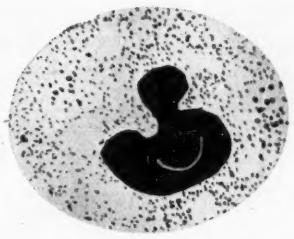


FIG. 1. — Diagram of polymorphonuclear leucocyte showing changes due to toxic influences, viz., pyknosis of nucleus, clumping of granules, and vacuolation of cytoplasm.

The other types of cells arising in the bone-marrow (myeloid leucocytes) cannot advantageously be classified in a similar manner. The eosinophilic and basophilic granular cells can simply be enumerated, because any more complex classification is not possible in the present stage of our knowledge of them. The large hyaline leucocyte (monocyte) is still too much the subject of controversy to be accurately classified. Even the source of this cell is still a matter of dispute. One of the most recent views as to its origin is that of Aschoff and Kiyono, who regard it as being derived from reticular supporting tissue, which is present in almost all parts of the body, i.e., from the so-called reticulo-endothelial system. It is convenient and probably accurate to accept the view of Naegeli and Alder as a working hypothesis, viz., that the monocyte is derived from the myeloblast, i.e., from the parent cell of the granular leucocytes.

Lymphocytes are always, so far as is known, derived from pre-existing lymphatic cells ; sometimes from obviously immature forms (lymphoblasts), which bear a slight resemblance to myeloblasts.

LEUCOCYTOSIS AND LEUCOPENIA.

It is essential to consider these subjects together, because, as a rule, they represent simply differences in the intensity rather than in the kind of response. The terms can be applied to increases or decreases respectively of all types of leucocytes, but it is often convenient to specify more accurately by speaking of neutrophilia, eosinophilia, basophilia, lymphocytosis, or monocytosis.

It will be obvious that some sort of classification of these conditions is essential, although no rigid distinctions are possible in most cases.

1. **Increased Functional Demand as a Cause of Neutrophylic Leucocytosis (Neutrophilia).**—Very many toxic and infective stimuli, besides such physiological states as digestion and pregnancy, can cause well-marked leucocytosis, which may occur with astonishing rapidity and without at first demonstrable hyperplasia of the formative organs, i.e., it is clear that a stock of suitable mature cells must be contained in the parent tissues. If the demand for leucocytes persists, there occurs hyperplasia of the parent tissue and so the increase is maintained; such a state is rarely a physiological one if the percentage of more immature cells (band forms) increases much above 4 per cent. Any infective malady illustrates the changes very clearly. First, there is extreme neutrophilia, with concomitant decrease and often disappearance of the eosinophils and basophils and great reduction of lymphocytes, i.e., in the marrow there is so great a production of neutrophilic cells that very few of the other types are produced; there is also a correlated hypofunction of lymphatic tissue. If the infection persists, it will be noted that the percentage of neutrophils falls, although the total number of leucocytes may increase or remain unchanged, and the other types of granular cells re-appear even if in smaller numbers than normal. These changes might well be supposed to be due to increase in the amount of functional marrow tissue—a view which can always be confirmed at autopsy. As the infection dies down, there is progressive decrease in the number of neutrophils, with increase of the other cell types to figures definitely above normal. These changes become even more marked during convalescence, so that post-infective lymphocytosis, eosinophilia, and monocytosis are observed. This series of extraordinary changes makes clear the need for repeated blood examinations whenever possible, and the necessity has been emphasized by the work of Hickling in my laboratories. He has shown that the post-infective changes may be so extreme in degree as to obscure the neutrophilic response completely. He has also shown that a number of important prognostic signs may be obtained by this means.

2. **Increased Functional Demand as a Cause of Neutrophilic Leucopenia (Neutropenia).**—Infections similar in kind, but much more intense than those just discussed, may so injure the formative tissues that no increase in circulating leucocytes occurs; but even so a differential count may reveal that there is great relative increase in the number of neutrophils, although a large percentage of them shows well-marked signs of degenerative change, which must, therefore, almost certainly be attributed to injury before the cells have left the bone-marrow, i.e., not after they have entered the circulation.

3. **Increased Functional Demand as a Cause of Lymphocytosis.**—It has already been mentioned that lymphocytosis occurs after many infective conditions as a sign of the onset and progress of reparative processes, i.e., it is an indication of an infective process which has been overcome, or at least is being held in check, rather than a sign of chronicity, although many a chronic infection is accompanied by lymphocytosis because it is really an infection which is being prevented from spreading. The lymphocytosis which is so invariable a concomitant of typhoid fever is of great interest here, because when it suddenly disappears the prognosis is very grave—

viz., the lymphocytosis indicative of the disease being held in check has gone. This is an example of

4. **Increased Functional Demand as a Cause of Lymphopenia,** which is usually a condition of the worst possible prognostic significance; but it must be recognized that leucopenia is not necessarily a process fundamentally different from leucocytosis. There are toxins which can give rise to leucocytosis or leucopenia according to their concentration, just as there are others which primarily inhibit cell production rather than stimulate it; e.g., the leucopenia of typhoid fever or of measles after the rash has appeared must be regarded as belonging to this latter group of cases.

It can be taken as a general rule that the absence or disappearance of the leucocytic response usual in any infection is of bad significance; e.g., the disappearance of the eosinophilia so typical of scarlet fever is seen only in very severe cases; this is an example of

5. **Increased Functional Demand as a Cause of Eosinopenia;** but the much more commonly observed condition is

6. **Increased Functional Demand as a Cause of Eosinophilia,** such as is seen in post-infective states, but particularly in association with infestations with parasitic worms, e.g., hydatids. In this connection it is well to remember that secondary infection of a hydatid cyst is accompanied by neutrophilia with great reduction of eosinophils. Eosinophilia seems to be a much less stable state than neutrophilia; i.e., the response of the body to the more lethal infections, which are accompanied by neutrophilia, is the more mobile.

7. **Decreased Functional Activity as a Result of Destruction of Formative Tissues.**—Extreme lymphopenia may result from widespread destruction of lymphatic tissue throughout the body, e.g., by tuberculosis. The most severe example of failure of the hæmatopoietic tissues is, of course, seen in aplastic anæmia; but a very severe form may accompany the great destruction of myeloid tissue resulting from infiltration by numerous metastatic malignant tumours.

8. **Increased Functional Activity as Result of Greater Size of Formative Tissues.**—The most obvious example of this type is found in the leukæmias, where the greatly increased amount of marrow is not, so far as is known, the result of increased functional demand.

Another example of greater surgical interest is found in status lymphaticus, in which condition there is excess of lymphatic tissue throughout the body associated with lymphocytosis in the blood. It would also seem to be possible that the lymphocytosis seen in such endocrine disturbances as exophthalmic goitre is due to some similar hyperplasia; this is observed most notably in the thymus in this malady.

9. **Increased Functional Activity as a Result of Irritation.**—This is seen most typically in cases in which a deposit of tumour (carcinoma or sarcoma) occurs in the bone-marrow. Leucocytosis, with emigration of immature cells of both the leucocytic and red series into the peripheral blood, results. Histologically, as might be expected, there are signs of destruction of marrow tissue as well as of its stimulation.

10. **Decreased Functional Activity as a Result of Persistent Demand.**—This group of cases is perhaps rather arbitrarily separated from those in (2),

but there seems to be good histological reason for so doing. Cases of prolonged suppuration may, after a time, show progressive diminution in the number of circulating leucocytes, although there has previously been well-marked leucocytosis. Here there is definitely degenerative change in the bone-marrow, i.e., there is more than simple failure to respond to a stimulus. Gelatinous degeneration is the histological expression of this state; the marrow-cells are decreased in number, and the interspaces are filled with structureless material, which may ultimately almost replace the myeloid tissue proper.

Figs. 2–7 illustrate some of the conditions here described.

THE RED CORPUSCLE AND ITS PATHOLOGY.

It is convenient at this point to describe some of the characters of the red cells, although they are usually of less interest to the surgeon than are the leucocytes. Red cells are formed only in the bone-marrow in extra-uterine life, but whether they are derived from an ancestral cell common to them and to the granular leucocytes, as suggested by Klein, or whether they have a separate mode of origin, is still uncertain. Whatever may be the truth as to the origin of the red cell, it is certain that it tends to undergo alterations in number and in structure as a result of stimuli similar to those occasioning leucocytic variations. It is essential to realize that one form of nucleated red cell (the megaloblast) is peculiar to embryonic life and to only two diseases, viz., pernicious anæmia and acholuric jaundice.[24,25] Most of the cells referred to in medical literature as megaloblasts are doubtless large normoblasts (macro-normoblasts).

The anæmias can be of little interest to the surgeon with the exception of those forms following hæmorrhage or long persistent chronic infections.

1. **Post-hæmorrhagic Anæmia** is a condition which very clearly shows some of the close inter-relationships between the leucopoietic and the erythropoietic mechanisms, i.e., between both main constituents of the bone-marrow. In the blood there are all the signs of active replacement of red corpuscles, and at the same time there is evidence of great production of leucocytes, which is seen in the form of well-marked neutrophilic leucocytosis.

It is convenient to include the various conditions in which blood is destroyed inside the body with the post-hæmorrhagic anæmias, e.g., anæmia due to snake venom and other hæmolytic poisons. There is, however, a very striking difference in the speed of regeneration of the blood in the two types of cases. In the hæmolytic ones the blood is brought back to normal much more rapidly than in those due to spilling of blood; these divergences seem to depend upon the retention of iron in the body in the former type of case. McMaster and Haessler have shown clearly that one of the main factors governing the spread of red marrow in the bones is the amount of iron available in the body.

2. **The Anæmia of Chronic Infections.**—It has already been pointed out that, when one type of leucocyte is produced in numbers much greater than normal, the other white cells are much decreased in quantity, and it seems that a demand for one type of leucocyte can cause grave disturbance of the normal correlation of the cytopoietic functions of the marrow if it persists

for sufficiently long; even the red cells may suffer from too long a leucocytic drain. The latter type of damage is as a rule slight, and is shown by some degree of anæmia associated with signs of active regeneration of the blood, viz., polychromasia, nucleated red cells, and punctate basophilia in the circulation. Much more rarely a true degeneration of the formative tissues occurs and the signs of active regeneration disappear from the blood, so that a form of aplastic anæmia results; both chronicity and severity of infection are factors in the occurrence of such a state.

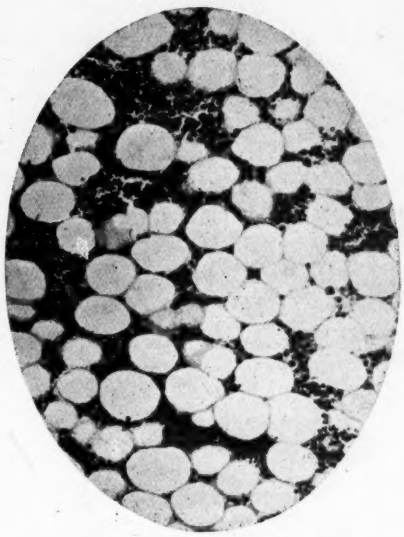


FIG. 2.—Normal bone-marrow. (× 90.)

3. **Anæmia due to Injury of the Marrow** is best illustrated by aplastic anæmia such as occurs occasionally in radiographers;[26] but a condition of greater surgical interest is that in which metastases of malignant tumours invade the marrow and injure parts of it, while stimulating the adjacent portions to greater, but less orderly, proliferation. In this condition, many nucleated red cells appear in the circulation; there is always a far greater number than would be seen in a secondary anæmia of similar degree. More rarely a very large number of erythroblasts may be seen in such a case even in the absence of anæmia; here the irritative stimulus of the metastasis is greater than is its destructive power. The more typical case must be presumed to possess its characteristic features as a result both of progressive destruction and stimulation of the myeloid tissue as a whole.

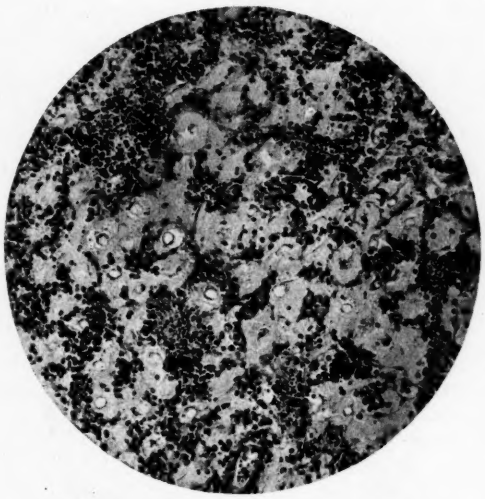


FIG. 3.—Gelatinous degeneration of bone-marrow, showing the decrease in the number of cells, together with deposition of structureless material in the interstices of the tissue. The tissue is from a case of persistent suppuration of a tuberculous knee-joint which had lasted several years. (× 90.)

The characters of the erythrocytic blood picture are as a rule of little surgical importance, but it may be convenient to indicate some of the deductions which may be drawn from them:—

1. Polychromasia and punctate basophilia in a blood with normoblasts in small numbers and a tendency for the leucocytes to approach normal are of good significance.

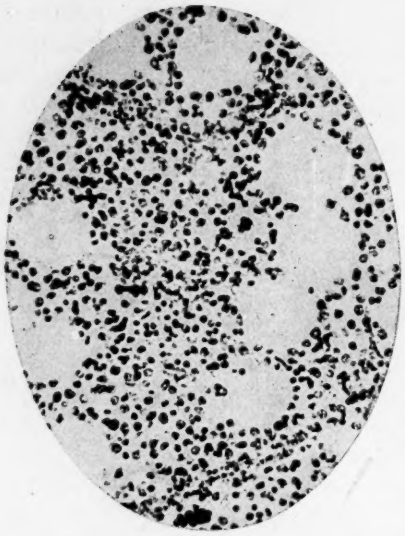


FIG. 4. — Hyperplastic bone-marrow, showing the decrease in number of fat spaces and the great excess of cellular tissue. The specimen was taken from a case of tuberculosis of the knee with secondary infection; leucocytosis had been observed for three months. (× 90.)

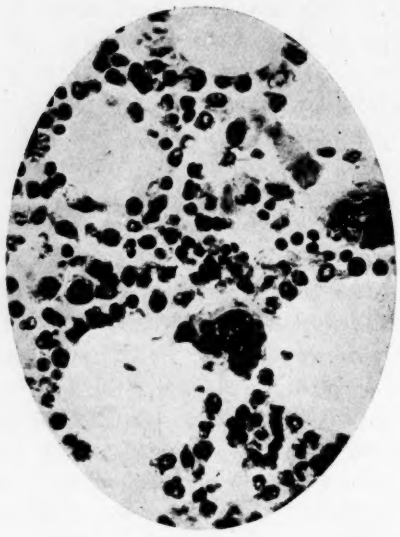


FIG. 5. — Hyperplastic bone-marrow, showing a part of the tissue seen in *Fig.* 4 at a higher magnification. The characters of the proliferated cells are better seen, and the participation of even the megakaryocytes is obvious. (× 225.)

FIG. 6.—Depletion of bone-marrow, showing almost complete absence of cells, with no signs of regeneration. The case was one of pneumonia following perforation of a gastric ulcer. (× 90.)

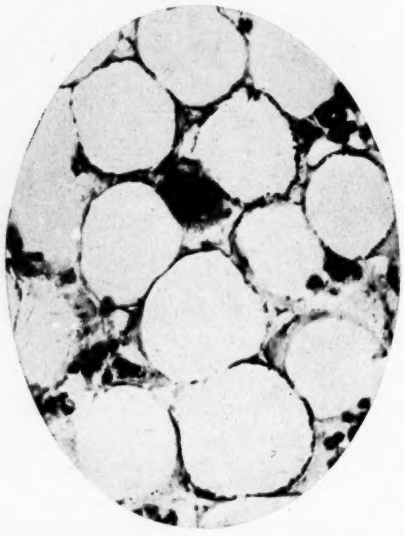


FIG. 7.—Depleted and injured bone-marrow, showing a part of the tissue seen in *Fig.* 6, at a higher magnification. The pyknosis of the nuclei is clearly seen. (× 225.)

2. A similar picture, but with the signs of regeneration much more intense, does not necessarily imply that the process of repair will be successful; much more frequently the prognosis in such a case is bad.

3. Persistently low numbers of red corpuscles, with scanty signs of regeneration such as absence of polychromasia, etc., and of normoblasts, is of evil significance; particularly is this so when associated with leucopenia, and perhaps even relative lymphocytosis.

THE LEUCOCYTIC BLOOD PICTURE.

The interpretation of various leucocytic blood pictures can now be discussed. In the following tables the leucocytes are arranged in the conventional manner; but the neutrophils are divided into myelocytes, young forms, band forms, and polymorphonuclears (mature forms) in the manner described above. The approximately normal percentage figures for the various types of leucocytes are as follows:—

Leucocytes, 6000 to 8000	Eosinophils, 3 per cent
Neutrophils, 67 per cent, of which 4 per cent are band forms and 63 per cent are polymorphs	Basophils, 1 per cent
	Lymphocytes, 23 per cent
	Monocytes, 6 per cent

It is most important to note that about 4 per cent of the neutrophils are of the band type, i.e., are slightly immature.

The character of the variations in infective conditions is well seen in the following case of joint suppuration in septicæmia. On the first day there is well-marked 'shift to the left' of the neutrophil nuclei, i.e., there is increase of the immature forms. There are 19 per cent of the young type and 17 per cent of the band form; it was not possible at this time to do more than state that the infection was indubitably a grave one, but no prognosis could be made. On the second day there was an orderly tendency to a return towards the right, i.e., towards maturity of the majority of the cells, although there were still many immature neutrophils; the less immature band type was present in larger numbers than the young type, whereas on the first day the strain on the marrow was so great that the young type was the more numerous. It was now fairly clear that such a leucocytic reaction was of good prognostic significance. On the twenty-first day, there was no longer any excess of immature forms, but the eosinophils were still scanty; this defect was overcompensated by the twenty-fourth day, when a well-marked eosinophilia occurred. The numbers of leucocytes are shown below:—

Days	Total Leucocytes	Basophils	Eosinophils	Neutrophils				Total Neutrophils	Lymphocytes	Monocytes
				Myelocytes	Young Types	Band Types	Polymorphs			
1	8500	—	—	—	19	17	31	67	19	14
2	7800	—	—	—	10	27	27	64	21	15
21	7300	—	1	—	—	1	56	57	29	13
24	10000	—	15	—	—	—	57	57	22	6

The next case was hæmatologically examined only by chance after operation for internal derangement of the knee. *Fig.* 8 shows graphically the series of leucocytic changes in this case, which steadily progressed to a fatal termination. The percentage

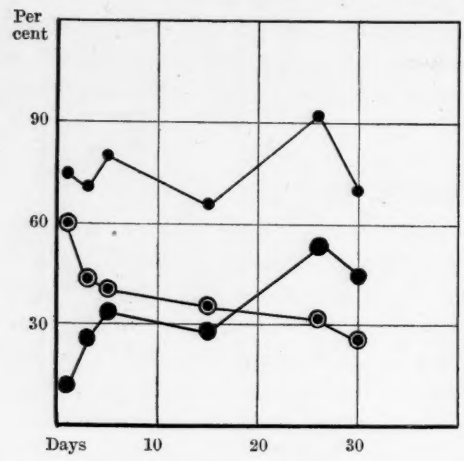


FIG. 8.— = Total neutrophils
= Mature neutrophils
= Immature neutrophils

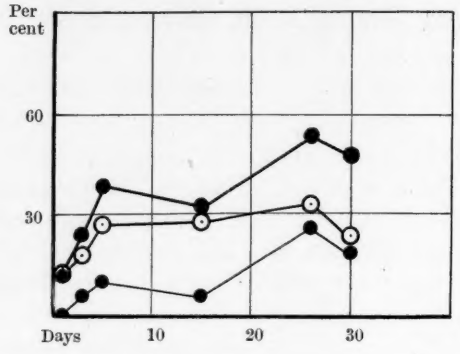


FIG. 9.— = Total immature leucocytes
= Band forms
= Young forms

of neutrophils was almost steady throughout the course of the illness, but gradually the immature forms became more numerous until they were in excess of the mature polymorphonuclear type. *Fig.* 9 shows the condition in rather finer detail because here the young forms and the band types are charted separately, and it is easy to note that it is the young forms which

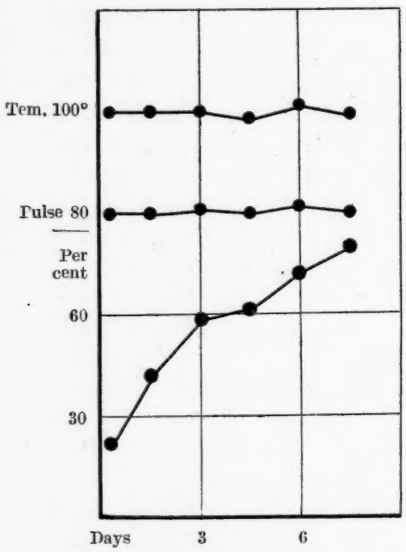


FIG. 10.—The rising percentage of immature cells (lowest curve) is clearly seen.

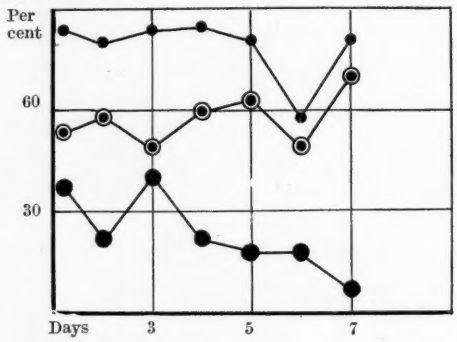


FIG. 11.— = Total neutrophils
= Mature neutrophils
= Immature neutrophils

increase; i.e., the marrow disturbance is so great as to result in production and emigration of cells only slightly more differentiated than myelocytes; this is a type of cell normally quite absent from the circulation.

Fig. 10 shows a feature of very great importance in a case of peritonitis. The temperature and pulse gave very little cause for anxiety, but the percentage of immature cells rose steadily (shift to the left), so that there could be no doubt as to the fatal termination of the case, which occurred on the seventh day of the illness.

It must not be supposed that features of importance can be obtained from the leucocytic picture only in fatal cases. *Fig.* 11 shows the series of changes in a case of erysipelas of moderate severity in which the clinical signs were most striking on the third day; this is seen to correspond to the time of maximum percentage of immature neutrophils on the chart. It is noticeable that on the seventh day there is an increase in the percentage of neutrophils, which might have been taken to indicate a recrudescence of the infection, but the progressive decrease of the less differentiated neutrophils was sufficient evidence to negative this view. It is obvious therefore that simple enumeration of the percentage of neutrophil leucocytes is not the sole or indeed the most accurate guide; the really important evidence is to be obtained by the discovery of either a rise or a fall of the immature types. It is not sufficient to find a steady percentage of mature cells or even a rising one, because rarely such a phenomenon may accompany a steady increase of the immature ones also; such a condition is of very evil prognostic significance. The factors governing the total numbers of neutrophilic leucocytes in the circulation at any one time are doubtless very numerous, and certainly are but little understood, whereas almost the only mechanism that is capable of causing progressive increase of immature forms is an infection; i.e., interpretation of variations in the total numbers of leucocytes is most likely to be subject to grave error.

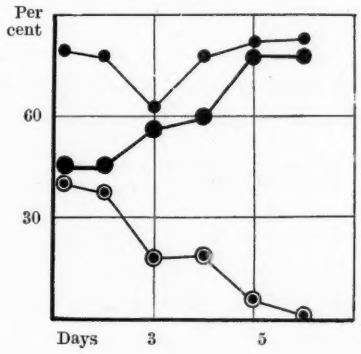


FIG. 12.— = Total neutrophils
= Mature neutrophils
= Immature neutrophils

The case shown in *Fig.* 12 was one of pneumonia following laparotomy for perforated gastric ulcer and generalized peritonitis. It is seen that at the time of the first examination—which took place on the fifth day of the illness—the mature cells were already less numerous than the immature ones. There is a progressive and steady rise of the immature forms until death, which took place on the eleventh day of the disease. If only the mature cells were taken as evidence of the gravity of the condition, it would be obvious that the prognosis was bad; but their fall is not as steady as is the rise of immature forms. If all the neutrophils were considered together, it would be easy to mistake the fall on the third day for evidence of improvement; but a glance at the numbers of immature cells is enough to negative this idea. *Fig.* 13 presents a similar picture from the same case; but here the gravity of the condition is even more obvious, because the young and the band forms are separately charted. The strain on the resources of the bone-marrow is so great that

the mature neutrophils and the band forms drop steadily while the young forms progressively rise, so that it is obvious that almost all the cells with neutrophilic granulation at the end of the disease are elements of a kind normally absent from the circulation; no better example of the importance of examining the cells as well as counting them could possibly be adduced. In this case the strain on the bone-marrow was so great that myelocytes appeared at the end of life; but it must be pointed out that myelocytes may appear in cases without such great shift to the left, and then have no evil significance.

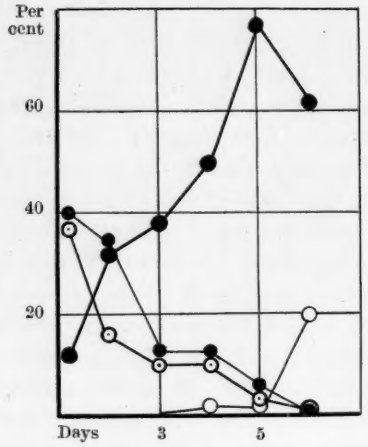


FIG. 13.— = Young forms
= Band forms
= Mature neutrophils
= Myelocytes

It may well be objected that a method of examination which requires to be repeated so frequently is of little value to the clinician, even if it is of great theoretical interest. This view is not really correct, because, as the following examples will show, much information of value can often be obtained from a single examination; but, of course, this is never so satisfactory a method.

It is well first to mention a case in which the changes were very well marked. The clinical diagnosis was one of abscess formation in the pelvis, and the blood examination showed:—

Leucocytes, 20,000	Eosinophils, nil
Neutrophils, 94 per cent, of which 19 per cent were young forms and 14 per cent were of band type, leaving 61 per cent of mature cells	Basophils, nil
	Lymphocytes, 5 per cent
	Monocytes, 1 per cent

There were well-marked leucocytosis and great increase in the number of immature cells in association with absence of eosinophils, so that no doubt as to the presence of pus could be entertained. The diagnosis was confirmed at operation.

The next case was clinically much less definite; there were slight rise of temperature, slight abdominal rigidity, and pain in the right iliac fossa. The provisional diagnosis was appendicitis. The blood picture was as follows:—

Leucocytes, 8000	Eosinophils, 1 per cent
Neutrophils, 75 per cent, of which 12 per cent were of band type and 63 per cent were mature	Basophils, nil
	Lymphocytes, 16 per cent
	Monocytes, 8 per cent

The leucocytes were not in excess of normal numbers, and there was not even a distinct relative neutrophilia. There was, however, slight shift to the left of the nuclei, although eosinophils still persisted in small numbers. It was clear that no inflammation or suppuration of severe character could be present, and at operation a scarred and slightly œdematous appendix was found.

The next case presented great clinical difficulties, in that a complaint of pain in the right iliac fossa was made by a mentally defective man, who had a scar in this region but could give no history of its origin. The blood showed :—

Leucocytes, 7500	Eosinophils, 1 per cent
Neutrophils, 48 per cent, of which 1 per cent were of band type and 47 per cent were mature	Basophils, nil
	Lymphocytes, 49 per cent
	Monocytes, 2 per cent

A blood picture of this type could not be reconciled with a diagnosis of inflammation, because there was no leucocytosis, no shift to the left of the neutrophils, and the eosinophils persisted although rather reduced in number. The definite lymphocytosis in association with the reduction of eosinophils seemed to indicate the presence of some chronic irritative but aseptic condition. At operation the appendix could not be found, but very dense adhesions were present in the region of the cæcum.

The next case was hæmatologically examined in the course of an investigation of the blood changes associated with convulsions. The patient suffered from Jacksonian epilepsy, and gave a history of a head injury some eight months previously; a dense scar was present on the scalp. The blood showed :—

Leucocytes, 6000	Eosinophils, 1 per cent
Neutrophils, 79 per cent, of which 8 per cent were young forms, 33 per cent were of band type, and 38 per cent were mature	Basophils, nil
	Lymphocytes, 8 per cent
	Monocytes, 12 per cent

No other case of convulsions had been observed with a blood picture even remotely resembling this one, and the characters were obviously those already recognized as due to infection. At operation, a cerebral abscess was found instead of a cortical scar, which had been presumed to be the cause of the convulsive attacks.

There can be but little purpose in increasing the number of examples of interpretation of leucocytic blood pictures here; enough has been said to make clear that a single blood examination may often be a sufficient guide to diagnosis, although definite prognostic indications can, as a rule, only be obtained by repeated examinations.

There are, of course, other types of blood picture in which some cell other than the neutrophilic granular leucocyte supplies the indications required by the clinician. Changes in the number of lymphocytes may be of great diagnostic importance, and are always of great theoretical interest. Most of the disorders of the endocrine tissues are accompanied by some variation affecting the lymphocytes, as is seen distinctly in the following case of exophthalmic goitre which was clinically typical :—

Leucocytes, 6300	Eosinophils, 5 per cent
Neutrophils, 49 per cent, of which 1 per cent were young forms, 3 per cent were of band type, and 45 per cent were mature	Basophils, nil
	Lymphocytes, 38 per cent
	Monocytes, 8 per cent

Here there is slight but definite lymphocytosis; the eosinophils are near the high limits of normal, and there is slight shift to the left of the neutrophils.

There is thus a peculiar mixture of hæmatological change: lymphocytosis and eosinophilia with shift to the left of the neutrophils, which is a condition very different from that seen in the infections discussed above.

A more intense example of changes of this character was seen in a case of adrenal tumour associated with alterations of the secondary sex characters:—

Leucocytes, 6700	Eosinophils, 8 per cent
Neutrophils, 39 per cent, of which 1 per cent were young forms, 2 per cent were of band type, and 36 per cent were mature.	Basophils, 1 per cent Lymphocytes, 37 per cent Monocytes, 15 per cent

Here the eosinophilia is even more marked. Monocytosis is common, but not invariable, in cases of endocrine disturbance.

Unfortunately it is not at present possible to make definite diagnoses in such cases simply from the blood picture, because defective functioning of other glands may give rise to similar changes. Lymphocytosis and eosinophilia are seen in association with polycystic kidneys, although here no shift to the left of the neutrophils occurs. In any case with a blood picture of this type it is essential to think first of the possibility of the condition having arisen after an infection, i.e., as a post-infective lymphocytosis with eosinophilia and monocytosis. It is, of course, obvious that examination of the blood must be only a part of the investigation of any case, and therefore errors of this sort are not likely to occur. The blood picture in Hodgkin's disease often closely resembles that of a post-infective state, but the clinical picture is almost certain to be sufficiently different. The following example of a case of lymphadenoma will show the similarity:—

Leucocytes, 7300	Eosinophils, 6 per cent
Neutrophils, 49 per cent, of which 1 per cent were of young type, 10 per cent were band forms, and 38 per cent were mature	Basophils, nil Lymphocytes, 39 per cent Monocytes, 6 per cent

It is not possible to lay down rigid criteria on which to base a prognosis in cases examined by these means, but some generalizations are of value, although they all require amplification by personal experience, and sometimes modification on clinical grounds. It has been my experience that as a rule a prognosis based on continued hæmatological examination is best not changed because at the moment the patient's clinical state does not seem to correspond: no definite opinion of the result of a case can be formed on one examination except in extreme examples. One record here should suffice. The case was one on which appendicectomy had been performed some eight months before the onset of the illness here described, which was at first supposed to be septicæmia of unknown origin. The blood picture was as follows:—

Leucocytes, 15,000	Eosinophils, nil
Neutrophils, 89 per cent, of which 43 per cent were young forms, 40 per cent were of band type, and only 6 per cent of mature cells	Basophils, nil Lymphocytes, 7 per cent Monocytes, 4 per cent

Here was a case with a very extreme degree of shift to the left of the neutrophils; the alteration was so great as to leave little doubt that recovery was impossible. A clinical diagnosis of subphrenic abscess was now made and the

patient was submitted to operation, when the abscess was found and dealt with. For the first three or four days clinical progress was good, but then the patient rapidly became worse, and died on the tenth day with a blood picture as follows :—

Leucocytes, 3600	Eosinophils, nil
Neutrophils, 93 per cent, of which 61 per cent were young forms, 30 per cent were of band type, leaving only 2 per cent of mature cells	Basophils, nil
	Lymphocytes, 2 per cent
	Monocytes, 5 per cent

There seems to be little doubt that here is an example of a case in which the formative tissues were so gravely injured that recovery was impossible because the defensive mechanism had been too greatly altered.

The following rules can be regarded as indications which will correspond accurately in almost every case to the course of an infective process :—

1. Slight neutrophilia with very little nuclear shift and with persistence of eosinophils is of good significance, and may not indicate a pathological state at all ; e.g., such a condition occurs in pregnancy, where, however, the percentage of eosinophils may drop without any appreciable fall in the absolute numbers of this type of cell ; this applies mainly to the later months of gestation. The following figures were obtained in the seventh month of pregnancy in a woman who had already borne two children and who appeared healthy :—

Leucocytes, 7600	Eosinophils,	3	per cent =	228
Neutrophils, 77 per cent = 5852 (of these 3 per cent were young forms, 11 per cent were band types, and 63 per cent were mature)	Basophils,	1	„ =	76
	Lymphocytes,	15	„ =	1900
	Monocytes,	3	„ =	228

Here there is slight shift to the left, but the absolute number of eosinophils is still within normal limits.

2. Slight or well-marked leucocytosis with definite nuclear shift of moderate degree (not more than 4 per cent of young forms and 12 per cent of band types), decrease of eosinophils, and slight decrease in the number of lymphocytes indicate a condition in which further examinations would be necessary before a prognosis could be given, although there could be no doubt of the presence of infection.

3. High leucocytosis with great shift to the left tending to progress in the same direction, with very great decrease or even disappearance of eosinophils and reduction of lymphocytes, is indicative of a grave condition, which may, however, still be recoverable. It is particularly when the young forms are in excess of those of band type that the prognosis is grave.

4. Recovery does not occur in those cases in which there is progressive fall of the total number of leucocytes with an extreme degree of shift to the left, total absence of eosinophils, and well marked lymphopenia.

5. Progressive eosinopenia with rising leucocytosis is never of good significance, unless

6. There is reappearance of the eosinophils and fall of the neutrophils, with reversion of the nuclear picture to normal, together with rise of the lymphocytes. It is clear that (5) represents the blood picture at the onset of an infection, and (6) the changes as it is overcome.

7. The development of lymphopenia during long-continued leucocytoses is of bad significance.

8. Sudden fall of lymphocytes in association with increasing neutrophilia and progressive nuclear shift to the left is of very grave significance, as is also a sudden fall of lymphocytes occurring during the course of a progressive decrease of the total number of leucocytes.

9. Lymphocytosis following neutrophilia, and accompanied by progressive passage of the nuclear shift towards normal and by eosinophilia, indicates recovery.

It is now necessary to speak briefly of the theoretical considerations relating to leucocytosis, because without such a discussion it is not possible to understand the principles underlying the interpretation of blood pictures.

The normal number of leucocytes in the circulating blood must represent the result of balanced processes, viz., production in the various formative organs and destruction at the periphery. In health, there seems to be but little variation in the intensity of these processes, and therefore the extreme of normal variation in number is not great. Arneth contends that the variations occurring in pathological conditions are the result of similar processes altered either by excessive production or by excessive destruction. Greatly increased production with only slightly increased peripheral destruction would result in leucocytosis with shift to the left of the neutrophils. Great peripheral destruction with only slightly increased formation in the marrow would manifest itself in leucopenia with nuclear shift to the left. Those infective states in which the total number of leucocytes is normal could be explained by the assumption that the increased formation is balanced by the excessive destruction; in such a state there would obviously be well-marked nuclear shift. Arneth's view, therefore, implies that every increase in the number of immature cells in the circulation must represent an increased and truly regenerative activity of the marrow; this conception is doubtless often in conformity with the known facts, but cannot be accepted for every case. Examples of leucocytosis not associated with increased peripheral destruction are seen in moribund persons where all types of marrow-cell are found in the circulation, in cases of metastatic tumours of the marrow, and in leukæmia. A blood picture with many immature neutrophils may arise as a result of infections which partially inhibit marrow function, so that maturation of the nuclei into the polymorphous form is delayed; in such a case many band forms may appear in the blood, to the partial exclusion of segmented types. It might be supposed that such a state was due to emigration of the ordinary immature neutrophilic cells; but this view is contradicted by examination of the marrow itself, because there is great increase in the number of cells with band nuclei at the expense of all other sorts of neutrophilic cells, i.e., inhibition of nuclear metamorphosis has occurred at a stage earlier than that of real segmentation; such a state might well be termed degenerative shift to the left. It has already been mentioned that normally the cells with lobulated nuclei are derived mainly from pre-existing granular cells with round nuclei (myelocytes), and that only a small percentage arises from the original ancestral form (the non-granular myeloblast), which is much more active in embryonic life

but is scanty in normal adult bone-marrow. Very long-continued infections are often associated with great increase in the number of myeloblasts in the marrow, with concomitant decrease of myelocytes. Leucocytosis with extreme degrees of shift to the left may be present in such cases; it seems almost certain that here the neutrophilic cell must be formed from its original ancestor, i.e., from a cell a stage earlier than that from which it normally arises. This fact may account for the predominance of band types in the blood, because the process of formation has started a definite stage earlier, and there has been insufficient time for the normal degree of maturity to be reached.

The conception of leucocytosis must be a mixed one; there is regenerative activity of the marrow, as is shown by the increase in the absolute number of neutrophils, but there is also in many cases evidence of degenerative change such as the presence of a number of immature cells greater than that normally present in the formative tissue. A leucocytosis almost entirely dependent upon the activity of an injured marrow is therefore possible, and such a condition is represented in *Figs.* 12 and 13, where at the end of life only immature cells were present in the blood. It is probable that in all cases there is a mixture of the two factors, viz., regeneration and degeneration.

The preceding part of this paper has dealt with hæmatology from the most usual aspect, viz., the changes occurring in the peripheral blood; but the key to such alterations is naturally to be found in the formative tissues, which are very cursorily dealt with in the second part of this communication. The structure of the bone-marrow will receive only passing attention here, because there is little new to write on the subject. Recent work on the finer histology of the lymphatic tissues in general has done much to clarify our conceptions of the histogenesis of many pathological states, and therefore the greater part of the available space will be devoted to it.

THE RETICULO-ENDOTHELIAL SYSTEM.

It is neither possible nor desirable to review the literature of this subject in detail; it has been done recently both by Aschoff and by Schittenhelm.

It has already been mentioned that Aschoff and Kiyono claim to have shown that some at least of the monocytes are derivatives of a third cytopoietic system. This reticulo-endothelial tissue is not admitted as the parent tissue of the monocyte by all writers, but its existence cannot be questioned. In normal circumstances only certain well-defined groups of cells in the body will stain with injected dyestuffs such as Indian ink—e.g., the inter-follicular cells of the spleen, the Kupffer cells of the liver, etc. It is to the whole series of cells capable of taking up into their cytoplasm such dyestuffs that the name reticulo-endothelial system is applied. It is a striking fact that the particles of stain are found lying inside the so-called endothelial cells as well as in the adjacent reticular cells (reticular phagocytes). It is possible by special histological methods to demonstrate that the fibres of these reticular cells really run through the substance of the 'endothelial' elements (Downey). With this method it is possible to see that the walls of the channels of lymphatic glands are lined partly by 'endothelial' cells through which run fibrils, and partly by

fibrils derived from cells lying deeper in the tissue. The two types of fibril are quite indistinguishable in structure, so that it seems to be necessary to regard the lining of such channels as being a functional rather than a morphological endothelium: it is a real reticulo-endothelium. These same cells are the ones which become distended with some unusual metabolic product in Gaucher's disease (*Fig.* 14), with lipoid substances in diabetic lipoidæmia (Schultze), and with cholesterol in cases of experimental overfeeding with that substance.

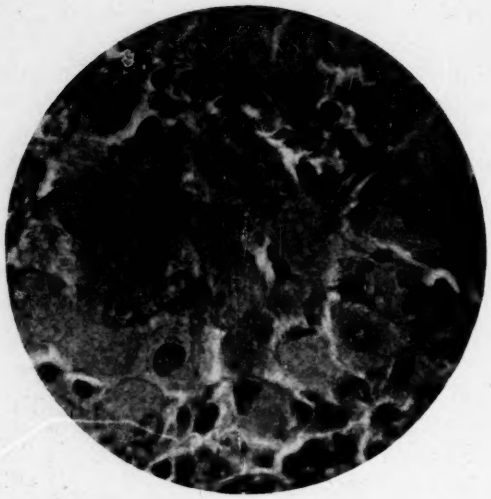


FIG. 14.—Gaucher's splenomegaly. (× 640.)

The very large 'endothelial' cells are clearly seen in *Fig.* 14, and it is obvious that their cytoplasm is finely fibrillated. These cells form the lining of the blood-channels; i.e., they occupy the position normally filled by the reticulo-endothelial cells of the spleen.

Neither the functions nor the morphological capabilities of the reticulo-endothelial system are as yet well understood, but it is already known that its potentialities are numerous. *Fig.* 15 shows the apparent origin of a Hassall's corpuscle in the thymus from reticulum, and here the relationship of cells to fibres is striking and easily determined. This structure, which has often been regarded as of epithelial origin, can here be seen to be composed of cells similar to some of the pulp-cells themselves, i.e., to result from condensation of reticular cells and fibres. The diffuseness of the distribution of the reticular cells in the thymus is similar to that in lymphatic glands (cf. *Fig.* 16).

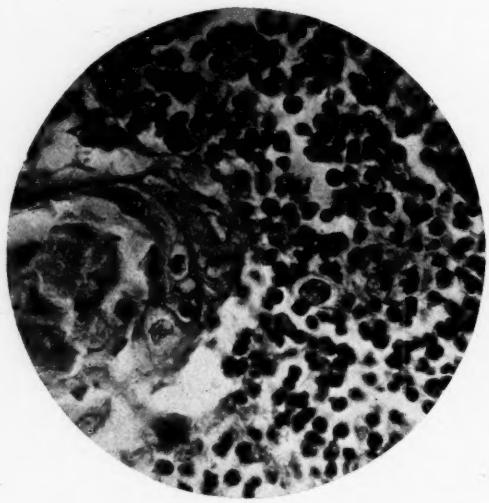


FIG. 15.—Hassall's corpuscle in the thymus. (× 640.)

There seems to be little doubt that the reticulo-endothelial system is the main mechanism by which effete red corpuscles are destroyed; this would explain why no hæmolysin is discoverable in most cases of hæmolytic anæmia; the lytic agent is a cellular rather than a humoral one.

The pathology of the reticulo-endothelial system does not open up knowledge of a new series of diseases, but makes clearer the nature of several obscure maladies.

Hodgkin's disease is a condition with extraordinary histological changes, which have received a large number of explanations, and to-day it is popular to regard it as being a 'lymphogranulomatosis', i.e., a disease in which the essential pathological change is one affecting lymphatic tissue proper. It is clear that there are very many histological differences between such obvious proliferations of lymphatic tissue as lymphatic leukæmia and Hodgkin's disease. It is much easier to mistake a hyperplastic lymphatic gland from the vicinity of a focus of chronic irritation for one from a case of lymphadenoma than to confuse the latter with lymphatic leukæmia. *Fig.* 16 shows hyperplasia of the 'endothelium' of a lymphatic gland, and it is easy to understand how further proliferation of this tissue would obliterate all the normal arrangement of the organ. The figure also shows how diffuse is the arrangement of reticulo-endothelial tissue in lymphatic tissues; this is made out only with difficulty in normal glands.

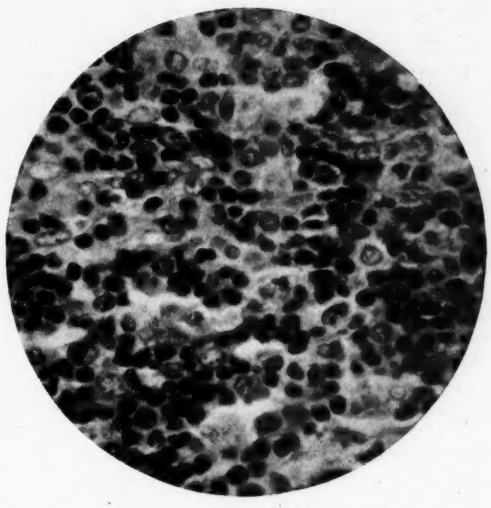


FIG. 16.—Diffuse 'endotheliosis' of lymphatic gland. (× 450.)

It is difficult in a normal gland to realize how widespread is the reticulo-endothelial tissue, but in the present specimen it is clear that endothelial cells are diffusely distributed throughout the lymphatic tissue. This diffuse cell system is here regarded as being the morphological basis of the lesion of lymphadenoma. The specimen was taken from a gland in the vicinity of a chronic gastric ulcer.

Histological examination of the lesions of Hodgkin's disease shows the presence of a great variety of cells, most of which bear little or no resemblance to the cellular constituents of normal glands, just as the arrangement is much less orderly than in health. Complicated explanations of these histological changes have often been suggested, but many objections have been found to them all. The very salutary clinical habit of avoiding multiple diagnoses whenever possible has been too much neglected in most of the explanations of the histogenesis of lymphadenoma. It has been supposed that all sorts of tissues were proliferating at the same time, viz., endothelium, lymphocytes, connective tissue, and even some unknown cells which give rise to the giant cells so typical of the disease. Such a series of explanations is deplorable when the malady is regarded as being an infective one, but when it is classified with the neoplasms it is untenable. It has already been pointed out that the bone-marrow normally produces a great variety of cells, but when called upon for an unusually great effort in the production of any one type its activity in giving rise to the others is much decreased. If a single section of normal bone-marrow were examined, it would be impossible even to guess at the close inter-relationships of the cells there seen. These facts make it obvious

that the great variety of cells seen in lymphadenomatous lesions is no good reason for presuming that they are not derived from a common ancestor. Such a monophyletic view as to the origin of the lesion presents one distinct difficulty in that a proliferation of reticulo-endothelium would not account for the lymphatic hyperplasia seen in the early stages.

It is probable that the increase of lymphocytes is due to the irritation of the proliferating reticulo-endothelium which fills all the interstices of the tissue; but it is not impossible that the lymphocyte itself is a derivative of this diffuse system of cells. If lymphadenoma be regarded as a disease affecting the reticulo-endothelial system, one is immediately presented with an explanation involving only one tissue, which is so widely diffused throughout the affected organs that it is only rational to expect normal structures to be distorted and even obliterated very early. The late stages of the lesion show disappearance of many of the cells and replacement by an almost non-cellular tissue, which can only be reticulum; it is quite certainly not ordinary fibrous tissue. One is still left to find an explanation of the giant cells, which are so characteristic a feature of the lesions. A suggestion as to their genesis can be found by comparison with other maladies known to affect essentially the reticulo-endothelial system. Brill and Mandlebaum have been able to show that the large cells in the spleen and other tissues in cases of Gaucher's disease belong to the reticulo-endothelial system, and this is a lesion in which giant cells are quite common. It is even more important to realize that giant cells closely resembling those occurring in lymphadenoma are occasionally seen in glands subjected to chronic irritation, so that there can be little doubt that the lymphadenoma cell is yet another manifestation of the activity of reticular tissue. In brief, the lesion of lymphadenoma can be regarded as one affecting the reticulo-endothelial tissue, and it is possible to distinguish three more or less distinct phases of the process: (1) Proliferation of the reticulum throughout the affected gland with consequent distortion of its normal arrangement, excess of lymphocytes and of 'endothelial' cells; (2) Proliferation of reticulum with production of 'endothelial' cells and an increased amount of fibrillar tissue, but with reduction in the number of lymphocytes; (3) Proliferation of reticulum with production of large numbers of fibrils and of very few cells.

The possibility of dividing the process into phases is not surprising when it is realized that manifestations of any one phase may occur in other conditions, although the whole series is necessary for the diagnosis of lymphadenoma. A large production of 'endothelial' cells is not uncommon in tuberculosis (*Fig.* 17), and sometimes in other chronic infections; the so-called chronic irritative hyperplasia of lymphatic glands is the most obvious example of this type. In this lesion there is ample evidence that, when the parent tissue is performing one function to excess, its other activities are curtailed; e.g., in such chronic hyperplasia there is defective lymphocytopoiesis and practically no reticulosis but excess of endotheliosis. The mixture of processes in Hodgkin's disease must therefore be apparent rather than real, i.e., the variety of cell types and the reticulum are not produced by the parent tissue at the same time, but represent successive changes. *Figs.* 18, 19, 20 show various stages and features of the lesion.

I have previously[27] suggested this idea of Hodgkin's disease as a reticulo-endotheliosis, and the view has been attacked by Sir H. D. Rolleston on the ground that, if the idea was correct, there should always be involvement of the Kupffer cells of liver and spleen. My contention is that the Kupffer cells are always affected when the spleen and liver are involved in the disease, but I do not suggest that lymphadenoma is a malady always affecting all the reticulo-endothelium of the body. The upholders of the view that Hodgkin's disease is a lymphogranulomatosis are not expected to be able to demonstrate that all the lymphatic tissue of the body is affected at the same time in every instance.

Other maladies have also been investigated from the point of view of the reticulo-endothelial system. *Gaucher's disease* is now usually admitted as being a lesion of this tissue, but it is interesting to understand how this view has been reached. Some of the conceptions as to the nature of the large cells typical of the disease are simply of historical interest, e.g., the teaching of Gaucher that the cells were epithelial—a view which was also shared by Picou and Ramond. Collier described the characteristic elements as being 'endothelioid'; Cornil noted that the cells resembled those seen in hyperplasia of lymphatic glands, and called attention to the fine connective-tissue framework, which he regarded as being the result of reticular overgrowth. Bovaird was even nearer than Cornil to a conception of the reticulo-endothelial character of the affected tissue, in that he described large alveoli separated from one another by thin lines of connective tissue from which nucleated cells projected. Brill, Mandlebaum, and Libman describe the essential change as one affecting the endothelial lining of the pulp spaces, or more properly 'venous capillaries', of the spleen. Schlagenhaufer took the position that the reticulum was the affected tissue, and that the large cells were not endothelium, but were swollen reticular elements. Brill, Mandlebaum, and Libman, in a later communication, state that the affected organs "show the presence of large cells with small nuclei and a peculiar hyaline cytoplasm, which arise from the endothelium or normal reticulum". Mandlebaum and Downey come very near to the view that Gaucher's disease is a special form of lesion affecting reticulo-endothelium in saying "that the characteristic cells of Gaucher's disease are derived from the reticular apparatus of the hæmatopoietic system,

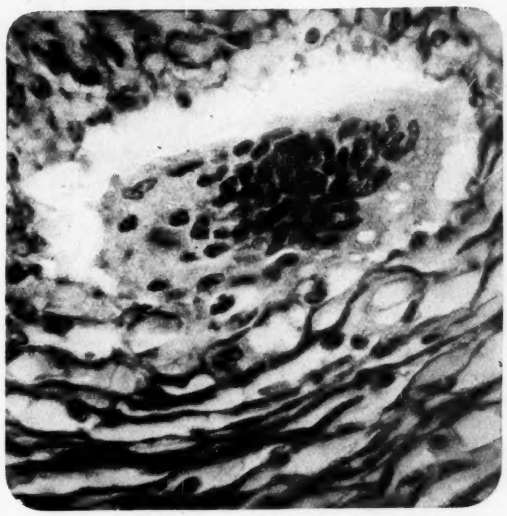


FIG. 17.—Tuberculosis in lymphatic gland. In the centre of the field is a giant cell, around which is much lamellated, non-cellular 'fibrous' tissue. Here, as in lymphadenoma, the reparative tissue seems to be reticular rather than fibroblastic in origin. The extremely close relationship of the reticular fibres to the scanty epithelioid cells is obvious in the lower part of the picture. (× 750.)

but the possibility of an additional origin from the endothelium of the venous sinuses in the spleen cannot be denied ".

It is now clear that it has never been possible to make sharp distinction

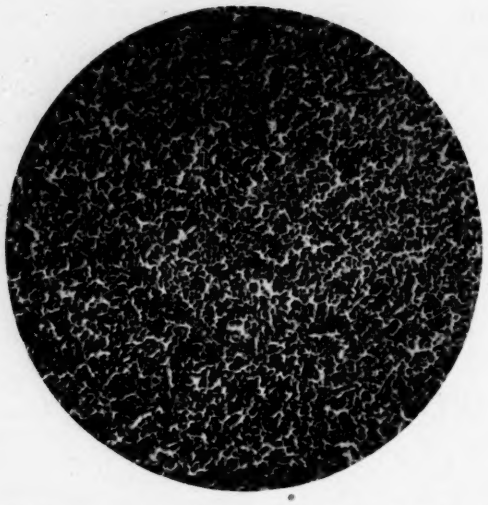


FIG. 18.—Lymphadenoma in lymphatic gland. The complete disorganization of the normal arrangement of the gland tissue is immediately obvious, as is furthermore its partial replacement by polymorphic cells. The only tissue so widely and completely permeating the lymphatic tissue as to be able to produce such disarrangement is that belonging to the reticuloendothelial system. (× 130.)

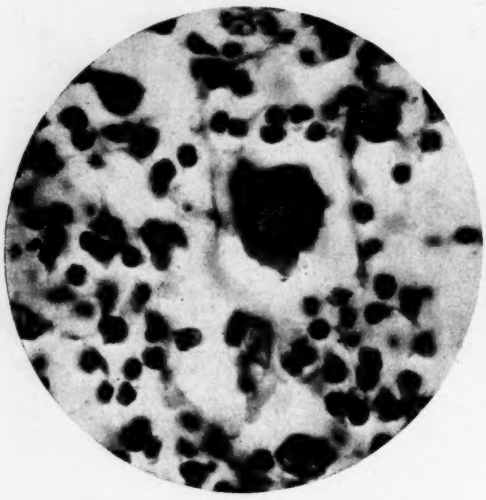


FIG. 19.—Lymphadenoma in lymphatic gland, showing the presence of a variety of cell types at a much more advanced stage of the lesion than that shown in *Fig.* 18. (× 540.)

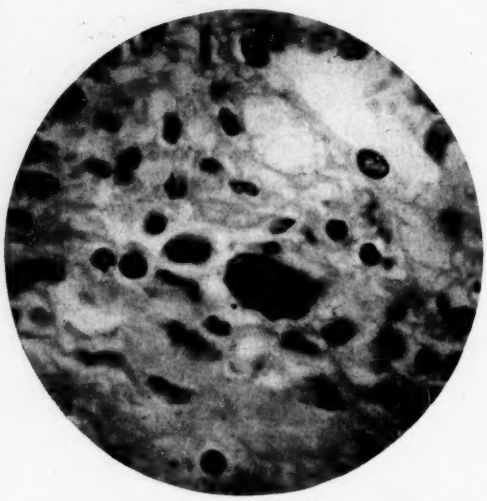


FIG. 20.—Lymphadenoma in lymphatic gland. The characters of the 'lymphadenoma cell' are here seen, and the diffuse deposition of non-cellular reticulum is also obvious. (× 540.)

between the reticulum and the endothelium of hæmatopoietic tissue, and in the light of more recent ideas as to their relationships it is obvious that this depends upon the interchangeability of the two structures. *Fig.* 14 shows

the typical appearances from a case of Gaucher's disease. The usually slight involvement of the Malpighian bodies doubtless depends upon the small amount of reticulum normally present in this region.

It is convenient here to describe some of the peculiarities of the intrasplenic circulation, because this is of interest in relation to the reticulo-endothelial system as well as to the causation of the site of metastases in this organ. *Fig.* 21 shows the course of the vessels in the spleen, as determined both by serial section of the injected organ, and by tracing out the course of the blood-channels in congested specimens. It will be obvious from the diagram that any one red or white corpuscle can pursue one of two courses, viz., either through the continuous channel to emerge through the venule, or through the short channels in the substance of the Malpighian body to enter the meshes of the pulp, from which it will be gathered up into the venous channels unless it is first engulfed by the 'endothelial' cells lining the pulp spaces. The factors governing the number of corpuscles following each course are quite unknown, but size might well be supposed to be of importance; there is no doubt that red corpuscles of abnormal dimensions are destroyed in the spleen in such diseases as pernicious anæmia and acholuric family jaundice, i.e., they must pass out of the main blood-stream into the pulp spaces. Other cellular elements of unusual size might also be expected to lodge in pulp spaces, and *Fig.* 22 shows a small mass of epithelial cells derived from a carcinoma of the liver lodged in a pulp space at the edge of a Malpighian body. The rarity of metastases in the spleen is probably due to the large size of most neoplastic masses preventing them from entering the pulp via the Malpighian channels; the propulsive action of the contractions of the organ may also facilitate onward passage of the tumour-cells.

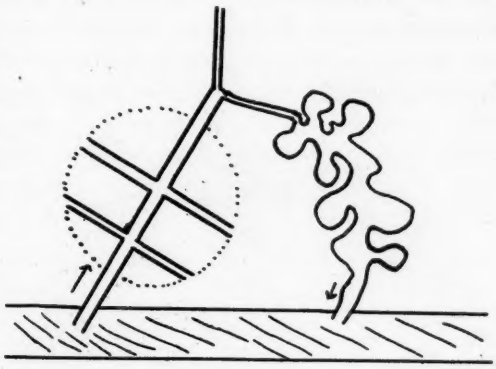


FIG. 21.—Diagram of the course of intrasplenic blood-vessels.

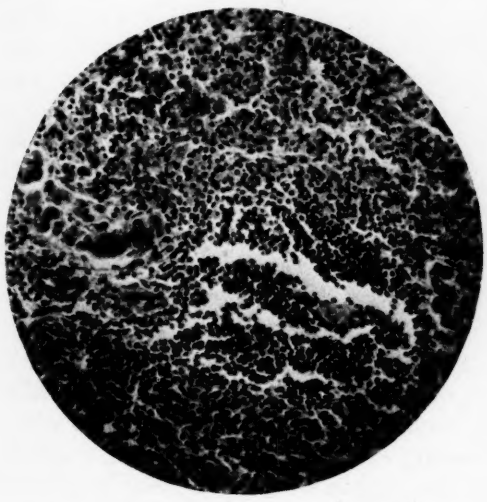


FIG. 22.—Metastases of liver-cell carcinoma in the spleen. Small collections of tumour-cells are lying in incomplete channels at the edge of a Malpighian body, which is the site at which they are to be expected. (Photograph from a specimen kindly given by Dr. D. Cappell, of Glasgow.) (× 135.)

It is perhaps doubtful whether the peculiar malady known as *Banti's disease* should be considered at this point, but its great surgical interest, and the possibility that it is related to the diseases just discussed, entitles it to some description. There is really no validity for the view that this malady has no separate existence, but is simply a hotch-potch of misunderstood splenomegalies; there can be but little doubt that Banti's idea that this is primarily a splenic lesion is a correct one, i.e., that the disease is a sort of 'hypersplenism'. It must be recollected that anæmia is one of the characteristic features of the disease, although no hæmolysin has ever been demonstrated; the blood destruction must therefore be a cellular rather than a humoral one. It is also important to note that 'fibrosis' (*Fig.* 23) is the last stage of the histological lesion in the spleen, i.e., it is quite probable that this is a 'reticulosis'.

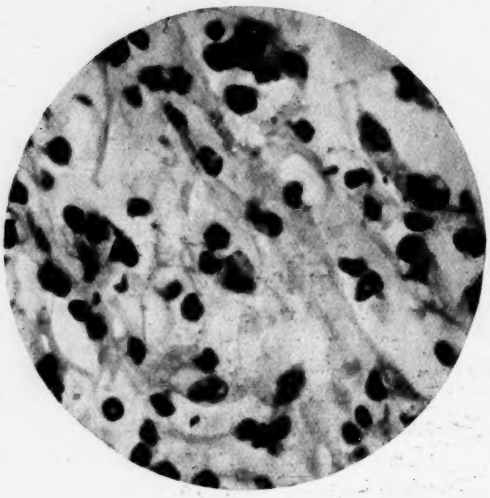


FIG. 23.—Spleen in Banti's disease. It is clearly seen that the so-called fibrosis of this disease is not cellular in character. (× 360.)

Gye and Purdy have shown that colloidal silica is a poisonous substance. They demonstrated that it was possible to cause alterations of the Kupffer cells of the liver with suitable dosage of this substance; repair of this lesion was by fibrosis, with development of a typical multilobular cirrhosis of the liver. Another form of cirrhosis also is known to be associated with injury of the Kupffer cells, viz., hæmochromatosis (bronzed diabetes). It would seem possible to correlate the reticulo-endotheliosis of the spleen with the multilobular cirrhosis of the liver, which is so characteristic of the late stages of Banti's disease in the light of these observations. Whether the appearance of proliferation of the reticulum in the liver in this malady depends upon transference of cells from the spleen to the liver, or whether upon the action of some noxa with greater affinity for splenic than for hepatic reticulum, cannot be determined. It is clear that the early stages represent involvement of the splenic reticulum alone, whereas the late stages, which are less susceptible of cure by splenectomy, differ in being a comparatively generalized disease of the reticulo-endothelial system.

METASTASES IN THE HÆMATOPOIETIC TISSUES.

Deposits of malignant tumours in the spleen have already been discussed. There can be but little purpose in a description of metastases in lymphatic glands, because their genesis has been worked out so very completely by Sampson Handley. It is here only necessary to refer to deposits of malignant tumours in the bone-marrow.

A summary of the evidence that such deposits reach the marrow via the blood-stream is all that is necessary here, because a detailed review of the available facts has been given elsewhere (Piney[21, 22]).

Deposits of malignant tumours in the long bones occur first near the upper ends, particularly in the femora and humeri, but much more rarely in the distal bones of the limbs. This site of election is supposed by Handley to result from permeation of lymphatics running centrifugally in tendinous and muscular attachments. If this view were correct, it should be usual to find that a tumour had eroded into the osseous tissue from without; but this is indeed a rarity. Almost invariably one observes that metastatic tumours occur inside the medullary cavity, often without any sign of even the slightest erosion of adjacent bone. It might, therefore, be supposed that

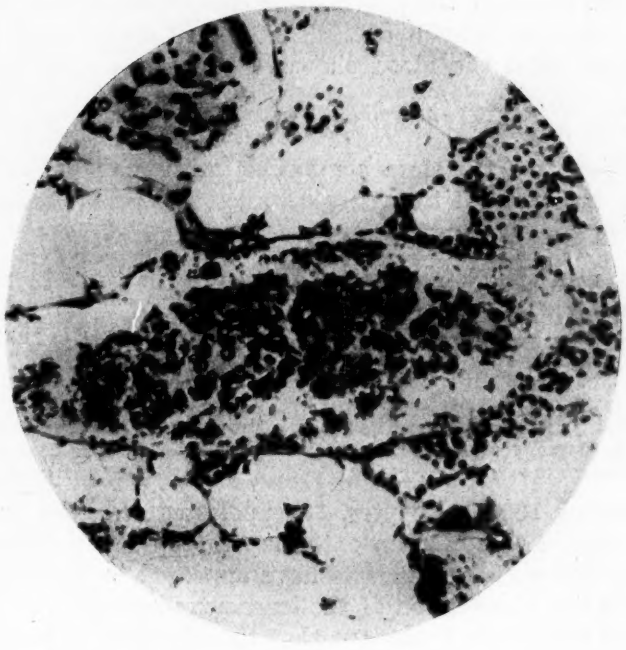


FIG. 24.—Metastasis in the bone-marrow of the femur.

the lymphatics of bone had been permeated by tumour-cells which so reached the bone-marrow and then spread on in that tissue. This idea is incompatible with the frequently demonstrated absence of lymphatic channels from the marrow[23]; deposits via the lymphatic channels could at the furthest reach the inner surface of the compact bone.

There is one very obvious difference between the contents of the medullary canal in the upper and the lower parts of the proximal long bones, viz., the former is composed of cellular marrow, while the latter is purely fatty in the adult. It seems certain that emboli could more easily be caught in the complex blood-channels of the red marrow than in the simple capillaries and arterioles of the fat. It is possible, in some cases of

metastasis in the marrow, to demonstrate that the tumour-cells lie inside blood-vessels (*Fig.* 24).

The presence of a growing mass in the hematopoietic marrow leads to definite changes in the morphological composition of the blood.[21, 22] The condition is of great interest, because its occurrence shows how difficult it may sometimes be to differentiate between leukæmia, an intense myeloid reaction, and metastatic carcinoma of marrow from the blood picture alone. The whole of the marrow is disturbed, so that the blood shows evidence of disorderly emigration of immature red corpuscles and cells. It must be realized that many nucleated red cells and immature leucocytes may appear in the blood in such conditions without there being any anæmia to account for the change, although it is more usual to see some reduction both of red corpuscles and of hæmoglobin.

One case will illustrate the points quite clearly, but not all the cases show a high colour index as did this one. The clinical diagnosis of this case was pernicious anæmia, and the blood showed :—

Red corpuscles, 3,000,000 Hæmoglobin, 80 per cent	Colour index, 1·3

The condition was therefore compatible with a diagnosis of pernicious anæmia if only the state of the red corpuscles was considered.

Leucocytes, 13,500.

This is a much higher number than is ever seen in uncomplicated pernicious anæmia.

The differential examination of stained films showed :—

Neutrophils, 60 per cent, of which 6 per cent were myelocytes, 8 per cent were young forms, 20 per cent were band forms, and 26 per cent were mature polymorphonuclears	Eosinophils, 1 per cent Basophils, nil Lymphocytes, 19 per cent Monocytes, 15 per cent Myeloblasts, 5 per cent

While counting 1000 leucocytes, 507 nucleated red cells were seen.

There is thus in this case an extreme degree of shift to the left of the neutrophils, so that even myeloblasts have appeared in the circulation. The gross changes in the distribution of the leucocytes and the very large number of nucleated red cells made it obvious that the diagnosis of pernicious anæmia should be changed for a tentative one of secondary deposits in bone-marrow. At autopsy, a primary growth was found in the stomach, and metastases were found in the vertebral column and in the upper ends of both humeri and both femora, i.e., in the usual sites. It is particularly important to correlate the clinical findings with the hæmatological ones in these cases, because a similar 'leukæmoid' blood picture may occur as a result of widespread septic infection of the medullary cavity, as is shown by the following case of a compound comminuted fracture, which was infected with both aerobic and anaerobic bacteria :—

Leucocytes, 65,000 Neutrophils, 81 per cent, of which 3 per cent were myelocytes, 29 per cent were young forms, 13 per cent band forms, and 36 per cent mature polymorphonuclears	Eosinophils, 1 per cent Basophils, nil Lymphocytes, 5 per cent Monocytes, 1 per cent Myeloblasts, 12 per cent

While counting 1000 leucocytes, 100 normoblasts were seen. It must be realized that the chance of development of such a leukæmoid blood picture as a result of infection of the marrow is limited by the comparatively small areas containing red marrow in the adult.

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SPONTANEOUS DISLOCATION OF THE HIP.*

By. R. WATSON JONES, Liverpool.

Spontaneous dislocation of the hip-joint, having a frequency undoubtedly greater than that of traumatic dislocation, and producing equally crippling results, has received far less attention than the latter condition. This study was based on a series of 5908 patients, of whom 27 were treated for spontaneous dislocation of the hip (i.e., all non-traumatic acquired dislocations), the incidence therefore being 1–219. In the same series there were only 2 cases of traumatic dislocation—an incidence of roughly 1–3000; so that whether spontaneous dislocation is to be regarded as rare or not, it is undoubtedly less rare than traumatic dislocation.

The cases include dislocations resulting from paralyses, both upper and lower neuron lesions, and from infections and degenerations of the hip-joint, of various types. One has preferred to class these cases together under the heading of 'spontaneous dislocation', avoiding the use of the term 'pathological dislocation', because one believes that the pathology of the condition is essentially the same whether it be due to paralysis or infection. The cases may be classified as follows :—

Table I.—Classification of Cases.

Dislocation from Muscular Paralysis :—		
Anterior poliomyelitis	6 cases	
Spastic paraplegia	1 case	
		— 7
Dislocation from Acute Arthritis :—		
Smith's septic arthritis	3 cases	
Pneumococcal arthritis	3 „	
Arthritis of exanthemata	2 „	
Pyæmic arthritis	1 case	
Arthritis of doubtful origin	3 cases	
Acute tuberculous arthritis	2 „	
		— 14
Dislocation from Chronic Arthritis	none	
Subluxation from Chronic Arthritis :—		
Tuberculous arthritis	2 cases	
Osteo-arthritis	3 „	
Hæmophilia	1 case	
		— 6
		27

Reference is also made to many others of this series of patients in whom similar diseases had not resulted in dislocation, in order thereby to establish more definitely the factors responsible for the condition.

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* Paper read at a meeting of the Liverpool Medical Institution, January, 1926.

PATHOLOGY.

It is taught that three factors combine to maintain the stability of joints—the shape of the bone-ends, the resistance of intra- and extra-articular ligaments, and the action of the surrounding muscles. But of these there is no doubt that muscular action is of primary importance. The shoulder-joint is stable in spite of its lax capsule, and in spite of the fact that the bone-ends are shaped for mobility and not stability. The crucial ligaments of the knee-joint are strong, yet they readily stretch and allow of subluxation when the quadriceps is paralysed and the hamstrings persist; or, conversely, they may stretch and allow of the production of genu recurvatum when the hamstrings are paralysed and the quadriceps is unopposed.

Similarly, in the hip-joint, although the shape of the bones is of the enarthrodial type, and although the capsular ligament is strong, the action of the muscles surrounding the joint is of supreme importance in the maintenance of its stability. It is one's endeavour to show that the pathological changes resulting in spontaneous dislocation are essentially muscular derangements, and not lesions of bone or ligament. In the first two groups of cases—the paralytic dislocations—this is obvious, the only lesion being a muscular paralysis. In those cases of dislocation following arthritis, although there may be bone destruction as well as disturbance of muscular balance, such bone destruction is not the essential factor in the displacement, and dislocation can occur without it, providing that the typical muscular derangement exists.

ANTERIOR POLIOMYELITIS.

An investigation of the six cases due to infantile paralysis shows that in all of them there is a fairly severe flexion-adduction contracture. The extensor of the hip (gluteus maximus) is always paralysed, and most of the abductors are paralysed (gluteus medius and minimus, tensor fasciæ femoris, and sartorius). The strong adductor muscles, and the equally strong iliopsoas, are therefore unopposed, and by their unrestricted tonic activity pull the thigh into the flexed-adducted position, which is afterwards maintained by the adaptive muscle shortening which occurs. Brief notes of the cases are quoted, to support these facts.

Case 1 (*Fig.* 25).—M. L., female, age 8. Spine and both lower limbs affected. Paralytic scoliosis. *Left lower limb*: Paralysis of adductors and gluteus maximus; flexion contracture 70°; abduction contracture 60°; hip normal. *Right lower limb*: Paralysis of glutei, tensor fasciæ femoris, and sartorius; adductors and psoas active; flexion contracture 70°; adduction contracture 40°; dorsal dislocation hip.

Case 2.—F. R., female, age 21. Both lower limbs affected. Flail below hips. *Right lower limb*: Paralysis of adductors and paresis of psoas; abduction contracture 30°; hip normal. *Left lower limb*: Glutei paralysed; psoas and adductors intact; flexion contracture 60°; adduction contracture 30°; hip dislocated dorsally.

Case 3.—F. H., male, age 8. Right foot and left lower limb affected. Glutei paralysed, abductors paralysed (except sartorius); adductors fair power; iliopsoas intact; flexion contracture 70°; adduction contracture 20°; dorsal dislocation hip—easily reducible but unstable.

Case 4.—I. A., female, age 8. Both lower limbs affected. *Right lower limb*: Weakness of glutei with slight flexion contracture. *Left lower limb*: Paralysis of all

glutei and of tensor fasciæ femoris ; flexion contracture 80° ; adduction contracture 30° ; dorsal dislocation left hip.

Case 5.—F. M., male, age 13. Right lower limb affected, and left lower limb slightly. *Right lower limb* : Abductors and extensors of hip paralysed ; flexors and adductors intact ; flexion contracture 70° ; adduction contracture 30° ; dorsal dislocation hip.

Case 6.—H. J., male. age 23. Right abdomen and right lower lower limb affected. Gluteus maximus paralysed ; other glutei weak ; adductors weak ; iliopsoas intact ; flexion contracture 60° ; adduction contracture slight ; hip subluxated but not completely dislocated.

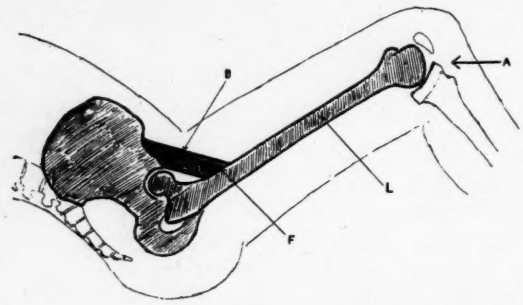

FIG. 25.—Diagram representing the existing theory of the mechanism of paralytic dislocation. It is assumed that a force (A), acting in the direction of the arrow, is assisted by a 'bowstring', the contracted flexors (B), a fulcrum (F), and the long lever of the femur (L). It is shown in the text that such a force is non-existent, and that flexion contracture alone does not cause dislocation.

The existing hypothesis of the mechanism of paralytic dislocation[1,2] is based on the assumption that the gluteus maximus is alone paralysed and the flexor muscles are shortened. The attachment of the contracted flexors is regarded as a fulcrum and the length of the femur as a lever, so that force

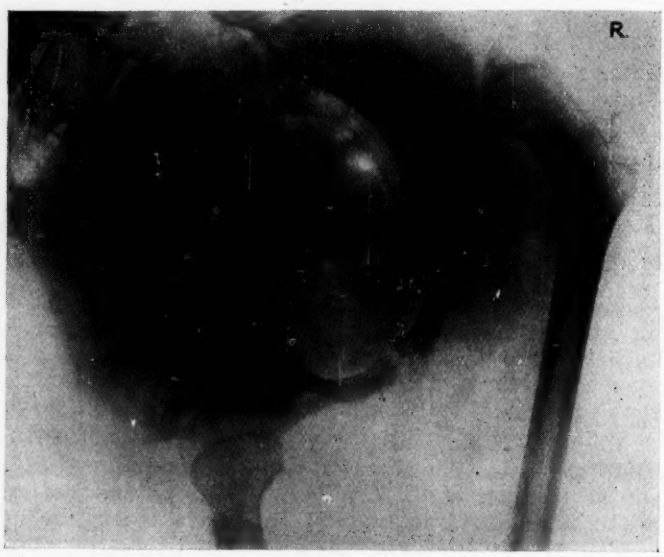

FIG. 26.—*Case* 1. Paralytic dislocation of right hip due to infantile paralysis. Pelvic tilting is masking flexion-adduction deformity on the right, and flexion-abduction deformity on the left. The roof of the right acetabulum is well formed.

applied to the knee displaces the femoral head backwards out of the acetabulum (*Fig.* 25). A history of such force, however, is never elicited, and, moreover, flexion contracture in itself does not result in paralytic dislocation.

Fig. 26 is instructive on this point, where both hips are flexed to 70°.

On the left this is associated with an abduction contracture and the hip is not dislocated; on the right the flexion contracture is associated with an adduction contracture and the hip is dislocated. The insufficiency of flexion in itself is shown in the following summary of all the cases of flaccid paralysis of the hip muscles in this series. The distribution of the paralysis in poliomyelitis is so capricious that a classification thus would be far too unwieldy. They are therefore classified according to the resulting deformity only.

Table II.—Classification of 157 cases of Flaccid Paralysis of the Hip Muscles, according to the Deformity Produced.

	Cases
Pure flexion	34
Flexion-abduction	20
Flexion-adduction	19
Adduction only	10
Abduction only	10
No contracture—	
1. Flail hip	28
2. All weak, but none paralysed	11
3. Only flexors paralysed	8
4. Muscles paralysed, but deformity prevented	17

A flexion deformity was therefore present in 73 cases. Adduction was associated with flexion in 19 cases, and in only 9 of these was the deformity severe. Of these 9 cases there were 6 with paralytic dislocation of the hip, and these were the only dislocated hips in the whole series of 157 cases.

Arguing from this fairly extensive series, it would appear clear that an unopposed activity of the flexors and adductors of the hip is the cause of paralytic dislocation. The mechanical explanation of this is readily forthcoming. In this position the head of the femur is only partly covered by the postero-inferior rim of the acetabulum—its shallowest rim—so that there is very little bony obstacle to dislocation.* The greater part of the head is in contact with the capsular ligament, which is also comparatively weak at this part (ischiocapsular fibres). Moreover, the capsule provides no greater resistance to muscular activity here than do the crucial ligaments in the knee-joint, as pointed out earlier.

Fairbank[3] has reported a case of a practically flail hip in which there was reducible subluxation (though not complete dislocation). Remarking on the rarity of paralytic dislocation, he points out that, in the few cases he has seen, there has been always a paralysis of the abductors with active adductors, and can only suggest in this case an habitual postural adduction as the cause of the displacement. Apart from the indisputable possibility of the subluxation being 'pre-paralytic', the paralysis and the subluxation may not have been directly related as cause and effect. It is within reason that the flail character of the hip was simply a condition predisposing to a displacement due to a comparatively mild and forgotten trauma.

Elmslie[4] believes that if complete paralytic dislocation occurs at all it is a most rare condition, the more common malady being subluxation. This

* This fact may be confirmed by articulating the dry bones. If the femur is flexed to 80° or 90°, an adduction of 30° is sufficient to send the head of the bone *gliding* over the posterior acetabular rim.

condition of subluxation is the first stage of all paralytic displacements, and, if the case is seen and treated at this stage, it is true it never goes any further. However, in a subluxated hip there is nothing to prevent complete dislocation except the capsule, and if the case is neglected, this, as I have already shown, will stretch and allow complete dislocation to occur. The question, therefore, as to whether a paralytic displacement is a subluxation or a luxation is, I believe, mainly a question as to whether treatment is adopted early or late, and the results of this investigation show that, in the past at least, complete dislocation has been the more frequent complication. The distribution of the paralysis may also effect the completeness of the dislocation. Flexion alone may produce subluxation similar to the temporary subluxation which frequently occurs during manipulation of the hips under anæsthesia when they are fully flexed. However, as in *Case* 6, the displacement never becomes complete unless the flexion deformity is associated with overaction of the adductors.

FIG. 27.—*Case* 7. Spastic paraplegia. Photograph to show flexion contracture on both sides, with adduction contracture best seen on the left.

SPASTIC PARAPLEGIA.

Although dislocation of the hip in infantile paralysis is undoubtedly rare (1–1000 orthopædic cases in this series), the similar dislocation in spastic paraplegia is of even greater rarity (1–6000).

Case 7.—(*Figs.* 27, 28) P. P., female, age 12. Paralysis first noticed when 9 months old. Spasticity both lower and upper limbs. Knee-jerks ++, ankle and patellar clonus, Babinsky - extensor response, plastic tonus ++, anarthria, mentality fair, severe flexion-adduction spasm and contracture of both hips. When first seen in the out-patient department, left hip dislocated dorsally, right hip normal. When admitted to wards this year, right hip also dislocated.

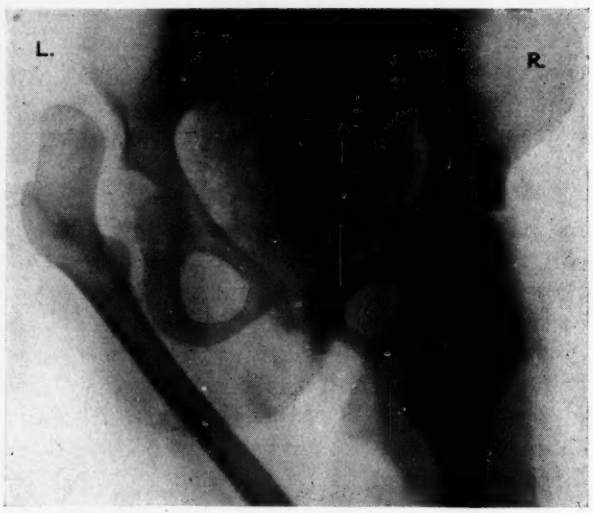

FIG. 28.—Skiagram of case shown in *Fig.* 27. Dislocation of left hip. Six months later the right hip was also dislocated. Both were successfully reduced by manipulation.

There is therefore no doubt as to the cause of the dislocation. The right hip was shown clinically and radiographically to be stable and not displaced, and six months later, without accident or disease, the same hip is dislocated.

Since the deformity of the hip in spastic paraplegia is again one of flexion and adduction, the mechanism of the luxation is strictly comparable with that already discussed under poliomyelitis. However, in contrast with the frequency of flexion deformity of the hip in poliomyelitis, due to the very common paralysis of the glutei, flexor spasm is rarely severe in spastic paralysis, and this accounts for the relative rarity of paralytic dislocation in the latter condition. Endless cases could be quoted to show that adduction spasm without flexor spasm is insufficient to dislocate the hip. Moreover, as in infantile paralysis, the converse is true—flexion unassociated with adduction does not cause spontaneous dislocation.

I have been unable to find in the literature any record of a similar case, but Mr. Elmslie has kindly supplied me with the notes of an unpublished case of spontaneous dislocation due to infantile spastic hemiplegia. The hip was known to be normal at birth in this child, and, as in the case just recorded, there was, in addition to the usual adduction deformity, a very severe flexion spasm and contracture.*

FIG. 29.—*Case* 17. Dislocation of left hip following acute arthritis, with marked destruction of femoral head and of acetabulum. During convalescence from the arthritis the child had an attack of infantile paralysis, which, by affecting the glutei, resulted in flexion and slight adduction contracture. Either condition alone was capable of dislocating the joint.

ACUTE INFECTIVE ARTHRITIS.

That acute infection of the hip is the most prolific source of true spontaneous dislocation is apparent from the classification above, 12 of the 27 cases being of this nature. Dislocation may complicate any acute arthritis of the hip, whatever the cause of the arthritis may be. Cases are recorded of dislocation in streptococcal,[5] pneumococcal,[7] influenzal,[6,8] scarlatinal,[9] and tuberculous arthritis,[10] as in the cases recorded here. It is also said frequently to occur in the arthritis of typhoid fever, although there were no such cases in this series.[11, 12, 13]

There can be no doubt that, in this type of dislocation, destruction of the head of the femur and of the acetabulum may be a very definite predisposing cause. Choyce[14] emphasizes the over-distention of the joint which may occur, with resulting laxity of ligaments. In a virulent destructive arthritis the joint may be so thoroughly disorganized that dislocation is inevitable, and this explains the frequency of the condition in acute infections. Such types of dislocation are seen in *Figs.* 29 and 30, where the usual shape of the bones is almost unrecognizable. Yet, on the

* Since writing the above notes, I have seen another case of displacement of the hip due to spastic diplegia in a man of 22. In this case there was a marked adduction contracture but very little flexion contracture, and the hip was only subluxated, not completely dislocated. This case strongly supports the suggestion that adduction in itself cannot cause complete displacement.

other hand, dislocation may occur in infective arthritis with practically no destruction of the head or acetabulum (*Fig.* 31). Moreover, dislocation may complicate non-suppurative arthritis of the hip.[8]

FIG. 30.—*Case* 13. Dislocation of the right hip following pneumococcal arthritis. The hip was very stable, and resisted all efforts at manipulative reduction.

Lamy,[15] in reporting two cases following pneumococcocal arthritis of the hip, points to the complete absence of acetabular deformity. He makes the somewhat improbable suggestion that the roof of the acetabulum is 'softened' though not destroyed, so that it cannot support the femoral head. The interesting point, however, is that in both cases the dislocation occurred quite suddenly during the acute phase, when there was marked flexion and adduction spasm. In all the cases I have examined the dislocation has occurred very rapidly, in the second or third week, when the infection is at its height and the muscle spasm greatest. There has always been a flexion-adduction deformity.

It is clear, therefore, that in all these cases, whatever the predisposing causes may be, the exciting cause of the luxation is muscular action, deranged as a result of muscle spasm and muscle atrophy being unequally distributed in different muscle groups. Arthritis of the hip, if untreated, almost inevitably results in flexion and adduction deformity, and it is this position which is most favourable for dislocation of the joint—the position which we have already found to be productive of paralytic dislocation.

FIG. 31.—*Case* 11. Dislocation of twenty-five years' standing due to acute arthritis. Note absence of bone destruction; the small femoral head is a result of non-development in accordance with Wolff's law. The patient complained of severe pain over the great trochanter, which prevented her lying on that side.

CHRONIC INFECTIONS, ETC.

The last group of cases, including the less acute infections of the hip, shows that in this type of joint affection, although incomplete displacement or subluxation is not uncommon, true dislocation is very rare. Complete dislocation does occur occasionally in arthritis deformans,[16] and of course in Charcot's arthropathy,[17] but in chronic arthritis as a whole it is notably rare. This fact supports the view that muscular action is the most important factor in the dislocations of acute infective arthritis. There may be an equally severe destruction of bone in both types of case, and presumably also the capsule may be infiltrated and softened to a similar degree; but the muscle spasm is undoubtedly greater in the acute case.

This suggested limitation of complete dislocation to the acute type of arthritis is well illustrated by the displacements of the hip due to tuberculous disease. Two of these were of a virulent and fulminating type, and the dislocation was complete. The other two cases were of the more slowly progressing type, and, although there was considerable bone destruction, the femur was only subluxated. These 4 cases were from a total of 91 tuberculous hips, the incidence of complete dislocation being therefore 1–45. In a total of almost 3000 cases of tuberculous disease of joints treated at the Institute Rizzoli, Vacchelli reports 750 cases of hip disease,[18] with one dislocation in every 27 cases. Although some of these were central or intrapelvic dislocations, the frequency of posterior displacement in his cases is remarkable. In one's own experience the condition which arises more frequently is that of 'wandering acetabulum'—a condition to be distinguished from true dislocation—which ultimately terminates in ankylosis with a stable hip.

FIG. 32.—*Case* 25. Subluxation due to osteo-arthritis. Complete dislocation is prevented by the locking of osteophytes.

In osteo-arthritis there is a further factor concerned which renders the joint less liable to dislocation. Unlike the almost purely destructive process of tuberculous infection, the simultaneous formative bone activity results in 'lipping' and osteophyte formation, which undoubtedly assist in the stabilization of the joint (*Fig.* 32). This, together with the absence of marked muscle spasm, makes dislocation a much less common complication than subluxation. From a total of 63 cases of osteo-arthritis of the hip there were, in this series, 3 subluxations and no dislocations. Max Page has recorded the details of 34 cases of osteo-arthritis of the hip, and one finds amongst them none with dislocation, but 2 with subluxation.[19]

FIG. 33.—*Case* 27. Hæmophilic disease of hips. Subluxation on right, although there is practically no bone destruction. Left hip, in spite of bone destruction, is not displaced, because it is extended and slightly abducted.

The case of hæmophilic disease of the hips was a puzzling yet a highly instructive one. The existence of hæmophilia was beyond question, but the condition was complicated by the presence of tuberculous glands in the neck, which on one occasion underwent caseation and abscess formation requiring aspiration. Certain features, however, suggest that the true diagnosis was hæmophilic disease.

Case 27 (*Fig.* 33).—F. W., male, age 4. Complained of limping on left leg when age 2. On examination hips flexed and adducted. All movements painful and limited. Muscle spasm ++. Treated with weight-extension, and later left hip in plaster (the extension strapping caused excoriation of the skin, which bled persistently). Twelve months later, child still walking with flexion deformity and lordosis. Still flexion spasm and slight adduction spasm of both hips. Some days can stand, other days too painful (? fresh hæmorrhage). Again on extensions. Three months later, non-fluctuating lump over left hip (? abscess or hæmatoma); disappeared in ten days.

Whether the true diagnosis is hæmophilic or tuberculous disease, the instructive point is that subluxation has occurred on the right—the side with the least bone destruction, but the side on which muscle spasm has been least controlled. On the left most of the femoral head is destroyed, but the limb is fully extended and slightly abducted, and no displacement has taken place.

CLINICAL SIGNS AND DIAGNOSIS.

It will be readily appreciated from the pathology as already discussed that spontaneous dislocation is almost invariably posterior, the head of the femur riding upwards on the dorsum ilii.* The clinical signs are as a rule clearly those of a backward dislocation. The existence of real shortening, raising of the great trochanter, 'hollowing' of Scarpa's triangle, broadening of the perineum, telescopic instability, and Trendelenburg's sign, make a clear picture when associated with the diagnostic sign of palpation of the head of the femur on the dorsum of the ilium when the thigh is rotated.

Occasionally, however, the signs are modified. In long-standing cases when suppuration has occurred there is considerable 'scarring' and fibrous-tissue formation round the head, which increases the stability of the limb and minimizes the telescopic movement possible. In some cases there is bone proliferation and osteophyte formation (*see Fig.* 30), or the formation of a pseudarthrosis and 'false acetabulum', which make the limb quite stable.

There is a point of importance in the diagnosis of paralytic dislocation. It must be realized that where the glutei are paralysed and atrophied it is possible to feel through them the normal head of the femur rotating *in the acetabulum*, if the limb is flexed and the thigh rotated. I have at various times seen four cases diagnosed as paralytic dislocation where the X rays showed no displacement, and feel sure that this accounted for the error. I have, moreover, made the same mistake myself in a boy with a flexion contracture, and have subsequently realized and confirmed the source of error. Further support is given to the mistaken diagnosis by the considerable shortening which may occur in the paralysed limb as a result of atrophy and failure of development. Moreover, in cases where the hip abductors are paralysed Trendelenburg's sign may obviously be present, whether the hip is dislocated or not—the abductors of the hip being more important than the opposite abdominal muscles in producing pelvic tilting.

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* The notes are on record[20] of one of Hilton's patients, in whom, following bilateral hip disease, there was a posterior dislocation on one side and an anterior (obturator) dislocation on the other. Since the case occurred in Hilton's practice in July, 1864, thirty years before Röntgen's discovery, there was no radiological confirmation of the clinical findings.

DIFFERENTIAL DIAGNOSIS.

It is of considerable importance, from the point of view of treatment, to distinguish spontaneous from congenital dislocation. Occasionally a child with a congenital hip dislocation suffers subsequently from an attack of poliomyelitis. The residual paralysis may be of the type which would cause paralytic dislocation, and the late diagnosis is difficult.

Fig. 34 is the photograph of a child admitted as a case of 'paralytic dislocation due to spastic paraplegia'. The diagnosis appears correct; the hip is obviously dislocated, and the paraplegia is severe. Nevertheless the skiagram (*Fig.* 35) shows the appearances typical of congenital dislocation, and the spastic paralysis is therefore a mere coincidence.

A boy of 15 years was examined, suffering from progressive muscular dystrophy, with severe wasting of the glutei, a flexion contracture of the hips, and a dislocation on the right. The dislocation, however, was not secondary to the myopathy, but was congenital in origin.

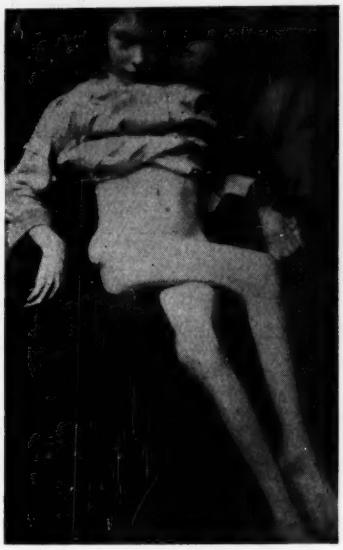

FIG. 34.—Severe spastic paraplegia with dislocation of right hip, thought to be paralytic in origin (note prominence of head of femur).

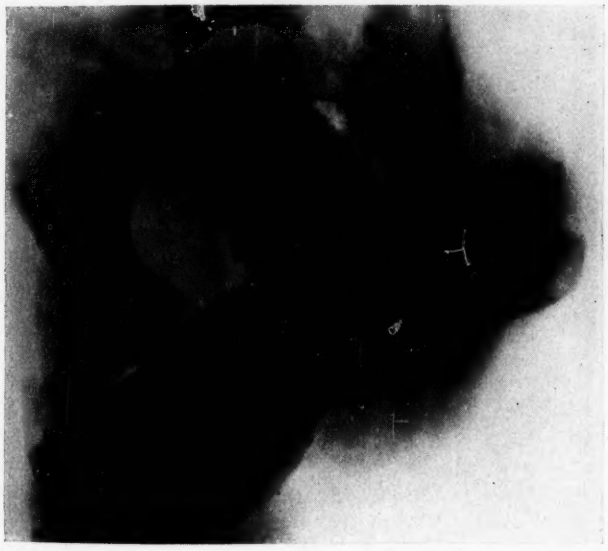

FIG. 35.—Skiagram of case shown in *Fig.* 34. In spite of the impossibility of securing a good skiagram in this case, it can be seen that the roof of the acetabulum is deficient, and the shape of the head of the femur suggests that the dislocation is congenital, not paralytic.

Again, suppuration may occur in the region of congenitally dislocated hips, and the appearances are those of dislocation due to suppurative arthritis—the 'pseudarthroses flottantes' of the French. I was fortunate in seeing a very excellent example of this in a child of 4. Twelve months previously abscesses had been opened in the groin and buttock, and during convalescence it was discovered that the hip was dislocated. Naturally the diagnosis made was dislocation secondary to acute arthritis of the hip. Yet one could not wish to see a skiagram more typical of congenital dislocation than that shown in

Fig. 36, proving that the suppuration was a secondary occurrence and not the cause of the dislocation. The history in these cases is as a rule confusing and unreliable, and the diagnosis often rests with the radiogram. The small deformed and displaced epiphysis of the head of the femur typical of congenital dislocation is never seen in my experience in the spontaneous displacement. The head may be destroyed in dislocation due to arthritis, and in accordance with Wolff's law it may undergo atrophy in long-standing paralytic dislocation; but it never presents the typical appearance seen in congenital dislocation (cf. *Figs.* 29, 31, 36). The roof of the acetabulum, moreover, is normally developed in spontaneous dislocations.

FIG. 36.—Typical congenital dislocation of right hip. Owing to suppuration in the region of the hip, a diagnosis of spontaneous or 'pathological' dislocation was made.

Finally, difficulty may arise in cases of spontaneous fracture of the neck of the femur. Osteomyelitis of the femoral neck, with spontaneous fracture, may in later years present all the clinical signs of dislocation due to infective arthritis. The 'pseudo-dislocation' due to complete atrophy of the neck of the femur in severe cases of infantile coxa vara (*Figs.* 37 and 38) can usually be distinguished from spontaneous dislocation by the history, and of course the radiological diagnosis is final.

FIG. 37.—Infantile or cervical coxa vara in a boy, age 7.

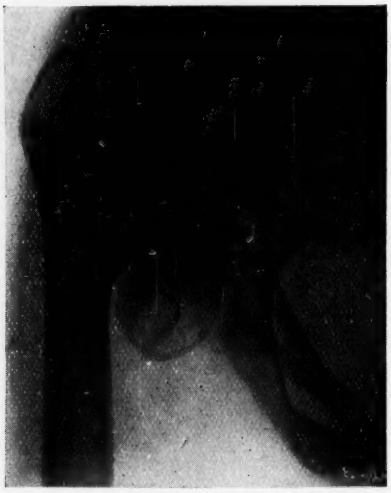

FIG. 38.—Same case as shown in *Fig.* 37, but ten years later. The neck of the femur has been completely absorbed, the head is sequestrated in the acetabulum, and the shaft is riding up on the dorsum of the ilium. Clinically, the condition resembled dislocation of the hip.

PREVENTIVE TREATMENT.

A discussion of the treatment of the dislocations under consideration is beset with difficulty. Not only are the underlying pathological changes at variance, but the clinical features of individual cases may differ so completely that each is a problem in itself. Yet, amongst the multitude of possible manifestations, one feature is outstanding in that it is common to all: the limb must have been flexed and adducted before the joint could have been dislocated. It follows that, however variable the corrective treatment may be, the principle of prevention is in all cases identical. It is, moreover, the infinitely more valuable preventive treatment that requires emphasis.

Provided that there is a clear understanding of the mechanism of the displacement, spontaneous dislocation need never occur in an age when the establishment of orthopædic clinics is ensuring earlier and more continuous treatment. I believe that spontaneous dislocation is rarely inevitable, and that in the great majority of cases it is an entirely preventable complication.

Having established the fact that the cause of spontaneous dislocation is a derangement of the normal muscular balance with the production of a flexion-adduction deformity, it is clear that the prevention of dislocation resolves itself into the prevention or early correction of that deformity, with a re-establishment of the muscular balance. In paralytic cases the over-activity of unopposed muscles must be limited by retentive apparatus, preceded, if the conditions demand it, by muscle slide or tenotomy. In spastic paralysis the flexor and adductor muscle groups are over-active as a result of the loss of the cerebral inhibitory control over the spinal centres. The power of such muscles must by operative measures be reduced; and, as far as possible, by physiotherapeutic measures, the power of their antagonists increased.

In cases of acute arthritis it is essential that the reflex muscle spasm of the flexors and adductors be prevented from producing a contracture of the hip. The limb must therefore be immobilized in the fully extended and slightly abducted position throughout the acute phase of the infection, existing deformity being previously corrected by traction in the line of the deformity.

In those cases of acute arthritis in which the head of the femur and the roof of the acetabulum are completely destroyed, simple correction of flexion and adduction spasm will obviously be insufficient to prevent dislocation. Since the bony elements of the joint have disappeared, the femur may ride up on the ilium with the limb in any position, and the essential element of the treatment is continuous and uninterrupted traction. In all other cases, where there is still a roof to the acetabulum, provided the roof is made use of by maintaining extension and abduction of the limb, dislocation in its ordinary form cannot occur.

Unfortunately, however, that Utopian state in which there is no treatment apart from prophylaxis is yet unrealized, and, whatever the future may hold, the demand for corrective measures still exists.

CORRECTIVE TREATMENT AND RESULTS.

GENERAL CONSIDERATIONS.

If further evidence were required to emphasize the importance of prevention, a consideration of the results of corrective treatment supplies it. The uniformly unsatisfactory results can be readily appreciated when one reflects that the dislocation of the hip is not the only, nor in many cases the worst, element of the disability. Poliomyelitis affects essentially the peripheral muscles, so that cases in which the hip muscles are involved have almost invariably a further involvement of the more peripheral muscles of the limb, and the addition of a flail limb to a dislocation of the hip obviously increases the difficulty of treatment and the gravity of the prognosis. In spastic paralysis there is an even greater obstacle to recovery in the muscular incoordination which exists. Even the dislocations of arthritis of the hip may be complicated by severe bone destruction. In formulating a course of treatment such associated disabilities must receive careful consideration. In all cases they will modify treatment, and in some may indicate the futility of any attempt to improve the patient's condition.

Four general criteria on which operative indications are based and results estimated may be enumerated in the following order: (1) Painlessness; (2) Stability; (3) Mobility; (4) Limp. Painlessness and stability are the primary objects at which to aim, at the expense if necessary of mobility. The fact that mobility of the hip-joint, though useful, is not essential, has been amply demonstrated by the results of arthrodesis for various conditions. A patient with a fixed and stable hip walks with much less limp than one with a mobile but unstable joint. The complete elimination of limping from the gait is the last consideration, and one which in my experience is rarely if ever attained in spontaneous dislocations.

ANTERIOR POLIOMYELITIS.

The ideal treatment of paralytic dislocation is reconstruction of the joint by manipulative reduction of the displacement, followed by immobilization in a stable position.

Manipulative Reduction.—Reduction of paralytic dislocation is seldom difficult, and may succeed several years after the displacement has occurred (*see Case* 3), although, as in congenital dislocations, the prognosis becomes progressively worse as the child grows older. The particular method of reduction which is favoured matters little, provided that the excessively forcible manipulations originally practised are avoided. Preliminary stretching or tenotomy of the shortened adductors may be essential, but complete correction of the flexion-adduction deformity should not be attempted before reduction of the dislocation. Such tight structures may be of considerable assistance in the reduction, and, moreover, it is clearly useless to correct flexion deformity and subsequently to immobilize the hip in the Lorenz position.

The position adopted for immobilization after reduction is important. Frequently the Lorenz position of 90° flexion with 90° abduction is utilized,

and certainly such a degree of abduction ensures stability and precludes all possibility of posterior re-dislocation (*see* p. 39). Flexion of this degree, however, cannot be other than harmful to the already overstretched and paralysed gluteal muscles, and favours a further contracture of the structures below the anterior superior iliac spine. If such a position is used at all, it must not be maintained for more than a few weeks. By gradually bringing the position of the hip down to one of pure abduction, the contracted flexor muscles and anterior capsule of the hip may be sufficiently stretched without demanding open methods. In many cases, however, open division of the contracted structures, or a muscle slide as described by Soutter,[23] is required to correct the flexion deformity.

The duration of plastic fixation necessary to stabilize a congenital dislocation is generally estimated at 8 to 12 months; but fixation for such long periods is only required because the roof of the acetabulum is undeveloped and deficient. In paralytic dislocations where the shape of the bones is normal few cases require fixation for a greater period than 3 to 6 months.

The only complication liable to occur in manipulations of this type is fracture of the neck of the femur. The close association of muscular action with the development of bone is well recognized; and in a limb affected by extensive paralysis, atrophic changes and failure of development occur in the bones to the same degree as in the musculature. Fractures of the femur are therefore more liable to complicate the reduction of a paralytic than that of a congenital dislocation.

In the application of the plaster the increased susceptibility of a paralysed limb to pressure sores must be borne in mind, and the greatest care taken to ensure an adequate and evenly distributed padding beneath the gypsum.

Reefing the Capsule.—The procedure of 'reefing' or 'double-breasting' the posterior part of the capsule of the joint, as an addition to the above treatment, has been recommended by Sir Robert Jones and by Ashhurst.[25] Although such a procedure may possibly augment the stability of the joint, it cannot supplant the necessity for the prevention of unbalanced muscular action, for, as has been insisted, contractile muscle is stronger than elastic ligament. All patients must be supplied with instruments; for although the dislocation is reduced, the glutei are still paralysed and there is still a tendency to the production of a flexion-adduction contracture.

Muscle Transplantation.—Theoretically, the correct treatment after reduction is an effort to supplement the power of the weakened glutei by transplanted muscles.[26] A. T. Legg has suggested reinforcement of a weakened gluteus medius by the tensor fasciæ femoris, and Lange has endeavoured to replace a paralysed gluteus maximus by the lower fibres of the erector spinæ, and to utilize the vastus externus in cases of paralysis of the gluteus medius. Like most other transplantations in the lower limb, these operations, though feasible in theory, are of little practical value.

Arthrodesis of the Hip.—In young children arthrodesis of the hip is unsatisfactory, because it is almost impossible to secure a firm bony ankylosis. When the cartilaginous head of the femur becomes completely ossified, the operation is feasible, and in certain cases constitutes sound practice. An absolutely stable and painless hip results, and the apparatus required to

enable the patient to walk is much simplified. The contra-indications of the operation are, however, very definite. Unless the muscles of the other hip and of the abdomen are strong, there is inability to swing the pelvis, and walking is impossible. In a case of this type not included in this series an arthrodesis had failed to enable the patient to walk, and the arthrodesed hip had subsequently to be excised in order that the patient might sit in comfort. Moreover, a flail-knee on the same side militates against the success of the procedure. Since in these cases the paralysis is usually widespread, the operation is only occasionally indicated.

Palliative Measures.—In certain old-standing cases none of the above procedures may be possible, and only palliative measures can be adopted. All reconstructive efforts may be abandoned and an attempt made to improve the patient's condition by the simple provision of a surgical boot with walking instruments, by simple tenotomy, or by the performance of an osteotomy to correct the line of weight-bearing; as an alternative the Lorenz bifurcation operation may be performed. Such methods of treatment are discussed more fully in a subsequent paragraph.

RECORDS OF CASES: SERIES I.

Treatment and Results in Lower Neuron Paralytic Dislocations.

Case 3.—F. H., age 8, anterior poliomyelitis, six years' history.
CLINICAL FEATURES.—Right: talipes equinovalgus. Left: talipes calcaneo-valgus, slight genu recurvatum, hip flexed and adducted. Dislocation on left (*see* p. 37).
TREATMENT.—Manipulative reduction. Plaster in Lorenz position (2 months). Re-plaster in abduction (5 months). Walking instruments.
RESULT.—Hip stable, mobile, and painless. No re-dislocation (10 years). Walks fairly well.

Case 4.—I. A., age 8, anterior poliomyelitis, four years' history.
CLINICAL FEATURES.—Right: slight coxa flexa. Left; talipes valgus, genu flexum, hip flexed and adducted. Dislocation on left (*see* p. 37).
TREATMENT.—Open division of hamstrings and of tight structures below anterior superior spine on left. Instruments.
RESULT.—Hip unstable. Becoming worse. To have arthrodesis.

Case 5.—F. M., age 13, anterior poliomyelitis, eleven years' history.
CLINICAL FEATURES.—Left: paresis of most of limb, especially of quadriceps. Right: talipes varus, thigh muscles weak, hip flexed, adducted, dislocated (*see* p. 38).
TREATMENT.—Walking instruments only.
RESULT.—Hip rather unstable, but can walk with instruments (fair).

Case 6.—H. J., age 23, anterior poliomyelitis over twenty years ago.
CLINICAL FEATURES.—Right: all muscles weak, coxa flexa, no adduction of hip, subluxation only. Paresis right abdominal muscles (*see* p. 38).
TREATMENT.—Nil operative. Massage, exercises, and re-education.
RESULT.—Subluxation not becoming worse. Walk improving.

Case 1.—M. L., age 8, anterior poliomyelitis five years ago.
CLINICAL FEATURES.—Left: genu flexum, hip flexed and abducted. Right: genu flexum, hip flexed, adducted, dislocated. Kyphoscoliosis (*see* p. 37, and *Fig.* 25).
TREATMENT.—Tenotomy flexors of thigh. Extension. Instruments.
RESULT.—Dislocation unreduced. Condition little improved.

Case 2.—F. R., age 21, anterior poliomyelitis twelve years ago.
CLINICAL FEATURES.—Right: hip abducted, flail below hip. Left: hip flexed, adducted, dislocated, flail below hip, extreme scoliosis (*see* p. 37).
TREATMENT.—No treatment would succeed in making patient walk.
RESULT.—Unrelieved.

SPASTIC PARAPLEGIA.

The treatment of cases of spastic paraplegia of such severity as to be associated with joint dislocation is technically of the greatest interest. Yet after months of treatment, involving countless anæsthetics and an heroic display of orthopædic armoury, the results are disappointing to the last degree. In most cases the disappointment lies not in the failure to effect reduction, but in the fact that muscular inco-ordination is so complete that the patients never learn to walk.

In this type of case reduction of the dislocation must invariably be preceded by an obturator neurectomy and possibly adductor tenotomy. At a later date, operative correction of flexion contracture may be required. Otherwise the treatment of the dislocation itself differs in no respect from that already discussed under the previous heading. The essential element in the treatment of the case as a clinical entity is the post-operative re-education; it is here where the greatest skill, patience, and untiring energy is required, and where failure is most likely to occur.

RECORDS OF CASES: SERIES II.

Treatment and Results in Upper Neuron Paralytic Dislocations.

Case 7.—P. P., age 12, Little's disease.
CLINICAL FEATURES.—Severe spastic diplegia (*see* p. 40, and *Figs.* 27 and 28). Has never stood or walked. Both hips dislocated.
TREATMENT.—Obturator neurectomy, tenotomy of flexors (except psoas), manipulative reduction of dislocation. Plaster immobilization in Lorenz position six months. (Both sides were treated thus on separate occasions.) Neck of left femur fractured during reduction. Also sciatic Stöffel and lengthening of peronei (right and left), tendon transplantations left forearm, manipulation of back, and plaster bed.
RESULT.—Mentality definitely improved. Hips stable and painless, deformities corrected. Patient never learned to stand or walk.

Case 29.—P. T., age 14, Little's disease.
CLINICAL FEATURES.—Severe spastic paraplegia, with congenital dislocation right hip (*see Figs.* 34 and 35). Has never stood or walked.
TREATMENT.—Obturator neurectomy, adductor tenotomy, and Soutter's muscle slide (right and left). Arthrotomy, right hip, attempted open reduction (unsuccessful because of deficient acetabulum). Also sciatic Stöffel, open lengthening tendo Achillis (right and left). Instruments and surgical boot. Re-education in walking.
RESULT.—Mentality undoubtedly improved. Hip unstable, 4 in. shortening (right). Can stand with instruments and a pair of crutches. Cannot walk.
(N.B.—This case, though not a true paralytic dislocation, is included here for comparative purposes.)

ACUTE ARTHRITIS.

Seventy years ago, in Charity Ward of Guy's Hospital, John Hilton was practising manipulative reduction of dislocation of the hip in the 'scrofulous

patient', followed by 'mechanical and physiological rest'.[20] To this day this is the method of election in early cases of arthritic dislocation.

Manipulative Reduction.[28]—If the case is seen while the suppurative process is still active, traction should be applied to prevent further displacement, abscesses drained, and general treatment instituted. At a later date formal reduction may be attempted, and at this stage of the disease will usually be successful. If the case is first seen some months or years after the dislocation, manipulative reduction may still be attempted, preceded, if necessary, by traction for some weeks. Successful results are more rare in such cases, because the upper end of the shaft of the femur is usually bound up in inflammatory fibrous tissue; reduction may be quite impossible, and other lines of treatment must be adopted as considered below.

The duration of fixation will usually be greater than that required in paralytic displacements, for in many cases the roof of the acetabulum is destroyed. It is possible that the bone-grafting operation for reconstruction of the upper acetabular lip,[29] advocated by Fairbank in some congenital dislocations, may be of value in this type of case. It was not performed in any of the cases reviewed below.

Two serious complications are prone to occur in reductions of this type. In recent acute cases attempted manipulative reduction during the acute phase of the infection may be followed by pyæmia or general miliary tuberculosis, according to the nature of the arthritis. At least one case of this type, with fatal termination, is on record in the literature.[30] In later cases there is little danger of lighting up a quiescent infection; but forcible attempts at reduction are very liable to be followed by fracture of the neck of the femur. This complication did not arise in any of the cases in this series, but has been reported by other writers.[2] Atrophic changes in the bones from both infection and disuse, and considerable resistance from the dense masses of fibrous tissue which surround the head of the femur, combine to facilitate the complication.

Non-reduction of the Dislocation.—It is a recognized fact that many people with congenital dislocations of the hip pass through life without ever seeking advice or treatment, and I recollect a patient of 48 who attended hospital for the first time in her life, with a congenital dislocation. If it is possible to secure moderately good function from an unreduced congenital dislocation, it is still more reasonable to assume that non-reduction of a pathological dislocation may be associated with very little disability. The relative stability of dislocations resulting from acute arthritis has already received comment, and it is true that some patients secure a fairly stable, painless, and reasonably mobile 'joint' without any operative interference. While this is true of a certain proportion, many patients sooner or later either limp badly, complain of pain, or find that walking is difficult. Such disabilities, however, are usually not due to instability—not due to the fact that the femur is not articulating with the acetabulum—but to one or more of the following conditions: (1) Real shortening, or apparent shortening from adduction deformity, causing limp; (2) Incorrect line of weight-bearing causing pain and limp: (*a*) fixed adduction deformity, (*b*) displacement of the bearing surface of the femur behind the line of weight-bearing; (3)

Compensatory lordosis or scoliosis causing pain in the back; (4) Prominence of the great trochanter with local tenderness; (5) Rarely—instability causing 'Trendelenburg limp'.

These considerations form the basis on which rational treatment is formulated. Where shortening exists alone, simple correction of this by alterations to the boots may be all that is required. Adduction deformity may be corrected by tenotomy of the adductors and manipulation, or more usually demands a simple osteotomy of the upper end of the femur. Where the incorrect line of weight-bearing is due to backward displacement of the bearing surface of the femur, the Lorenz bifurcation operation is indicated. Lordosis due to backward displacement of the femur, and 'Trendelenburg limp' with instability, are also indications for a bifurcation osteotomy. Tenderness over a prominent great trochanter was clearly demonstrated in one case, and was cured by correction of the adduction deformity.

Simple Osteotomy.—For conditions of this nature a wedge osteotomy is sometimes recommended,[32] though most cases are satisfactorily corrected by a simple trans- or subtrochanteric linear osteotomy. When there is considerable flexion deformity, a transtrochanteric osteotomy is preferable to a lower one.

Lorenz Bifurcation Osteotomy.—In this procedure an oblique osteotomy correcting deformity is combined with implantation of the lower fragment in the empty acetabulum, in the endeavour to secure a normal line of weight-bearing and to improve stability.[33]

Although this was performed in only one of the cases noted below, there is no doubt that it has a very definite place in the treatment of spontaneous as well as of congenital dislocations.

RECORDS OF CASES: SERIES III.

Treatment and Results in Cases of Dislocation from Acute Arthritis.

Case 12.—P. B., age 1 year and 3 months.
CLINICAL FEATURES.—Pneumonia when 7 months old; few weeks later, hip painful. Pathological dislocation.
TREATMENT.—Abscesses incised and drained. Hip immobilized. Dislocation reduced 1 month later. Plaster in abduction (6 months). Cork in boot.
RESULT.—Hip stable and painless. Movements very limited. Walking well.

Case 9.—D. S., age 1 year and 4 months.
CLINICAL FEATURES.—Septic arthritis right hip when 6 weeks old. Pathological dislocation.
TREATMENT.—Abscesses had been incised and drained and hip immobilized. Dislocation reduced (6 months later). Cork in boot.
RESULT.—Hip stable and seldom painful. Walks fairly well.

Case 8.—G. H., age 2.
CLINICAL FEATURES.—Septic arthritis right hip when 3 months old. Hip dislocated.
TREATMENT.—Manipulative reduction. Plaster in Lorenz position (8 months).
RESULT.—Stable painless hip. Walks well.

Case 20.—C. B., age 5.
CLINICAL FEATURES.—Tuberculous hip, onset eighteen months previously. Hip recently dislocated.

TREATMENT.—Manipulative reduction. Plaster in abduction. Cork in boot.
RESULT.—Fibrous ankylosis in good position. Walks well, only a slight limp.

Case 13.—V. B., age 6.
CLINICAL FEATURES.—Pneumococcal arthritis four years previously. Hip dislocated. Severe flexion and adduction (*see Fig.* 30).
TREATMENT.—Three attempts at manipulative reduction failed.
RESULT.—Hip quite stable and almost painless. Walks with very bad limp (flexion deformity and shortening). To have a transtrochanteric osteotomy.

Case 14.—H. D., age 6.
CLINICAL FEATURES.—Pyæmic arthritis three years ago. Right hip ankylosed in flexion. Left hip luxated.
TREATMENT.—Transtrochanteric osteotomy on right. No operative treatment on left. Cork in left boot.
RESULT.—Can walk two or three hours without pain. Both hips stable. Left hip movable. No deformity.

Case 17.—A. G., age 10.
CLINICAL FEATURES.—Acute arthritis of hip three years ago. Poliomyelitis during convalescence. Talipes calcaneo-cavo-valgus. Slight genu valgum and flexum. Hip flexed, adducted, dislocated (*see Fig.* 29).
TREATMENT.—Transtrochanteric osteotomy correcting flexion and adduction. Cork in boot. Caliper.
RESULT.—Still wearing caliper. Appears satisfactory.

Case 16.—L. S., age 8.
CLINICAL FEATURES.—Acute arthritis two years ago. Dislocation. Hip tends to adduct on weight bearing.
TREATMENT.—Linear osteotomy through trochanter. Abducted. Surgical boot.
RESULT.—Hip not very stable. Is walking, but limps.

Case 18.—D. S., age 15.
CLINICAL FEATURES.—Arthritis of doubtful origin five years ago. Dislocation. Hip flexed and stiff.
TREATMENT.—Lorenz bifurcation osteotomy. Cork in boot.
RESULT.—Hip stable and practically painless.

Case 19.—T. H., age 25.
CLINICAL FEATURES.—Old pathological dislocation since 5 years of age. False acetabulum. Quite stable but adducted.
TREATMENT.—Tenotomy of adductors and manipulation into abduction. Surgical boot.
RESULT.—Walks with limp. Hip is tending to adduct again, pelvis tilted.

Case 21.—G. M., age 23.
CLINICAL FEATURES.—Tuberculous hip, onset when 7. Dislocated. No flexion, slight adduction deformity. Fair movement.
TREATMENT.—Cork in boot, 4 in., to correct shortening.
RESULT.—Satisfactory. Hip stable. Limps.

Case 10.—P. H., age 7.
CLINICAL FEATURES.—Septic arthritis when 9 weeks old. Dislocation. No deformity. Shortening, $2\frac{1}{2}$ in.
TREATMENT.—Surgical boot. Cork, 2 in. heel, $1\frac{1}{4}$ in. tread.
RESULT.—No pain, but hip unstable and 'Trendelenburg limp'.

Case 15.—W. W., age 11.
CLINICAL FEATURES.—Arthritis five years ago. Dislocation. Shortening, 2 in. Poor acetabulum, head and neck of femur destroyed.
TREATMENT.—Cork in boot, 2 in. heel, 1 in. tread.
RESULT.—Unsatisfactory. Hip mobile and lax, sometimes painful. Walks with limp.

Case 11.—C. D., age 29.
CLINICAL FEATURES.—Acute arthritis in infancy. No deformity. Shortening, 3 in. (*see Fig.* 31). 40° of flexion movement, practically no abduction movement.
TREATMENT.—Has been treated by surgical boot for some years.
RESULT.—Has walked well and without pain until recently. Recently movement of hip is painful, tenderness over great trochanter.

CHRONIC ARTHRITIS.

Little need be said of the treatment of the incomplete displacements of chronic arthritis. Failing more radical measures, further displacement is prevented by the methods outlined earlier. In many cases the treatment is that of the underlying lesion, unmodified by the fact that subluxation has occurred. In osteo-arthritis, for instance, 'excision-arthroplasty' is performed in bilateral cases, arthrodesis in unilateral cases, and possibly in certain patients a pseudarthrosis below the hip.

In the complete dislocations of Charcot's disease (of which there were no cases in this series), a weight-bearing appliance such as Thomas's walking caliper, or other form of stabilizing apparatus, is the best available method of treatment.

RECORDS OF CASES: SERIES IV.

Treatment and Results in Cases of Subluxation from Chronic Arthritis.

Case 22.—Age 8.
CLINICAL FEATURES.—Tuberculous hip, onset six years ago. Subluxation.
TREATMENT.—Recumbency, with traction in extension and abduction. Thomas's knee splint and pattern. Thomas's caliper. Cork in boot, 1½ in.
RESULT.—Hip stable and painless. No tendency to displacement. Mobility—20° of flexion and extension. Walks with limp.

Case 23.—G. S., age 13.
CLINICAL FEATURES.—Old tuberculous hip with subluxation.
TREATMENT.—Correction of shortening by 1 in. cork.
RESULT.—No tendency to further displacement. Walks well.

Case 24.—G. B., age 52.
CLINICAL FEATURES.—Osteo-arthritis—advanced on right, with subluxation.
TREATMENT.—Arthrodesis of hip.
RESULT.—Hip stable, painless, and in good position. Walks very well, very slight limp. Slightly awkward in sitting.

Case 25.—L. W., age 55.
CLINICAL FEATURES.—Bilateral osteo-arthritis, with subluxation on both sides (*see Fig.* 32).
TREATMENT.—To have excision when admitted to hospital.

Case 26.—A. W., age 49.
CLINICAL FEATURES.—Unilateral osteo-arthritis, with subluxation.
TREATMENT.—Pseudarthrosis (Robert Jones's technique).
RESULT.—Hip painless, but flexion deformity is well marked. Walks with stick, limps rather badly. Can sit in comfort.

Case 27.—F. W., age 4.
CLINICAL FEATURES.—Hæmophilic disease of hips (*see* pp. 43, 44, and *Fig.* 33).
TREATMENT.—Recumbency, traction in extension and abduction. Plaster in abduction.
RESULT.—Can walk now, but both hips are flexed.

One feels that a review of the four preceding series of cases amply justifies the suggestion already made, that the results of corrective treatment are uniformly unsatisfactory. This applies particularly to the paralytic dislocations, where, apart from the dislocation itself, there is an extensively distributed muscular paralysis. In the arthritic dislocations it is clear that good results can only be expected in early cases where it is still possible to reduce the displacement. In late cases, where only palliative measures can be adopted, though the patients themselves are frequently satisfied, the results are far from ideal. On the other hand, in chronic arthritis, subluxation does not as a rule materially affect the prognosis.

SUMMARY.

1. Spontaneous dislocation of the hip is due to a flexion-adduction deformity of the hip. Flexion alone or adduction alone may cause subluxation, but cannot produce complete dislocation.

2. Paralytic dislocation occurs usually in lower neuron lesions, when the extensors and abductors are paralysed, and the flexors and adductors unopposed.

3. Paralytic dislocation may occur in upper neuron lesions if there is over-activity of the flexors as well as of the adductors.

4. Spontaneous dislocation in infective arthritis of the hip is due to muscle spasm of the flexors and adductors with atrophy of the extensors, and is sometimes aided by bone destruction.

5. Complete dislocation rarely occurs in chronic hip infections, because there is less muscle spasm.

6. Spontaneous dislocation must be distinguished from congenital dislocation with secondary paralysis, myopathy, and infection.

7. The condition can be prevented in both paralysis and infection, by preventing flexion-adduction deformity and by restoring muscular balance.

8. Though most cases can be improved, corrective treatment as a whole is unsatisfactory, because in many cases the dislocation is associated with other irreparable damage.

In conclusion, I would record my gratitude to the Honorary Surgeons of the Royal National Orthopædic Hospital. Each of them has given me considerable assistance, and allowed me a free hand in the use of his cases. I also wish to express my appreciation of the assistance of Mr. McMurray, of Liverpool, whose cases have also been utilized in the preparation of this paper.

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MULTIPLE POLYPI OF THE COLON.

By Sir W. I. de C. WHEELER, Dublin.

Polyposis of the intestinal tract is not by any means as rare as was formerly supposed. The relative frequency of polypi in the rectum is probably more imaginary than real, for the ease of diagnosis in this situation is in sharp contrast to the difficulties encountered when other portions of the alimentary canal are invaded. Difficulties, both in diagnosis and treatment, were encountered in two recent cases of polyposis of the colon which have stimulated the desire to place them on record and to review some of the literature. In the first case the condition was not recognized either before or during the course of two operations, and yet the findings were so definite that, if a second similar case were encountered, recognition during operation in all probability would present little or no difficulty.

CASE REPORTS.

Case 1.—**Polyposis with Symptoms of Ulcerative Colitis.**—In May, 1924, a girl, age 26, was admitted to Mercer's Hospital, with a history of constipation, followed after the use of laxatives by loose bloodstained motions which had persisted for two years. Stated briefly the symptoms were those of ulcerative colitis. Palpation revealed tenderness over the right segment of the colon, and an elongated tumour could readily be felt. The temperature ranged from 99° to 102°, running normal for two or three days at a time. Loss of weight, anæmia, pyrexia, and the presence of a tumour led to the clinical diagnosis of a malignant or tuberculous tumour of the cæcum. The possibility of actinomycosis, colospasm, or a specific lesion was considered. No definite information was forthcoming from X-ray examination; the report stated that "twenty-four hours after the barium meal the bowels had moved several times, and very little barium remained in the colon. Some was in the transverse and some was in the pelvic colon, but the relationship of the tumour to the bowel was not defined".

First Operation.—After some preliminary treatment with arsenic and by blood transfusions the abdomen was opened.

The colon presented a quite unfamiliar appearance. From just above the cæcum (which was normal) to the junction of the descending with the pelvic colon, the walls were hyperæmic, and infiltrated to such an extent as to convey the impression that any rough handling or angulation would break it in two. There were no adhesions. The ileum and pelvic colon were short-circuited, an appendicostomy was established, and, after removal of a small portion of the bowel wall for examination, the abdomen was closed.

The late Professor O'Sullivan reported that the specimen showed no signs of malignancy, but septic inflammation of the mucous membrane was present.

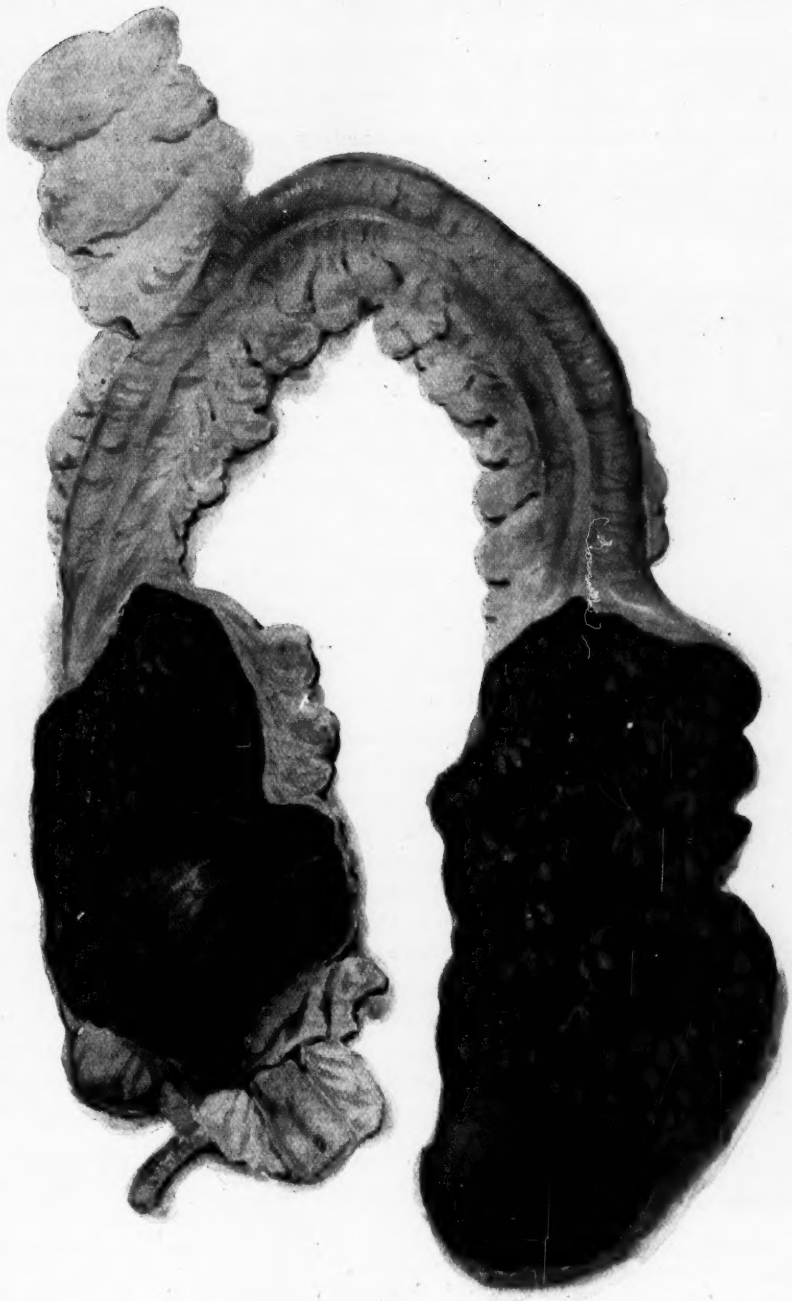

FIG. 39.—Polyposis of the colon. Drawing made immediately after removal. The cæcum and lower portion of the pelvic colon were free from polypi. The specimen weighed 2½ lb.

After three weeks' irrigation through the appendicostomy the patient was discharged from hospital to the country, and told to report again in six months.

On re-admission at the end of this period the tumour on the right side could still be felt. The X-ray report was as follows :—

After six hours the cæcum was incompletely filled and found very irregular in outline. The bowels had moved several times, and only traces of barium were present in the ascending, transverse, and descending colon. A large, oval-shaped, barium-filled sac was shown lying obliquely in the pelvis, and more to the right than the left side.

As this barium-filled sac was not present at the first X-ray examination, it was assumed that the barium collected at the line of the previous ileocolic anastomosis. For five months pain and diarrhœa had continued, but the hæmorrhage which had been present before operation had now ceased.

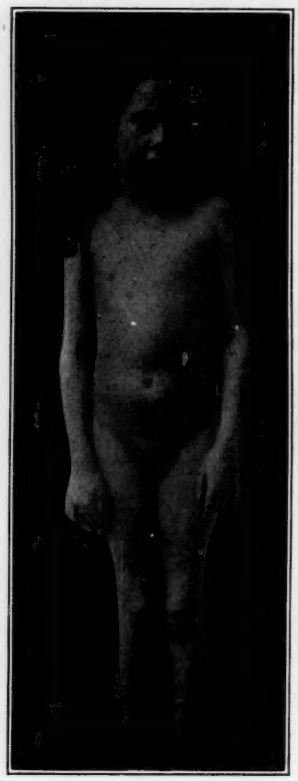

FIG. 40.—Infantilism in a girl, age 16, with polyposis of the colon.

SECOND OPERATION.—The abdomen was again opened. Neither the appearance nor the feel of the colon had changed ; there was the same rigidity of the walls from a level above the cæcum to the pelvic colon ; these two portions were normal, and in striking contrast to the remainder of the bowel. A long tube was passed up the rectum and guided through the anastomosis between the ileum and pelvic colon. The colon was removed from the ileocæcal junction to the line of anastomosis. The specimen weighed 2½ lb. (The weight of the average normal colon is approximately 1 lb.) When opened, myriads of polypi were found studded over the mucous membrane without interval from a line just above the cæcum to the lower portion of the pelvic colon (*Fig.* 39).

On the third day after operation the patient became distended, the tube passed through the ileocolic anastomosis did not drain, and ominous black vomiting supervened. Lavage of the stomach and efforts to establish drainage were unsuccessful, and the patient died. An autopsy was refused. The polypi on section were of the adenomatous type.

Case 2.—**Infantilism due to Polyposis of the Colon.**—The second case was seen in March, 1925. The patient was a girl, 16 years of age, stunted and dwarf-like, but not emaciated. Since early childhood she had suffered from diarrhœa and the passage of blood in the stools. Her height on admission to hospital was 4 ft. 5 in. and her weight 4 stone 13 lb. (The average normal height at this age is 5 ft. 1 in., weight 7 stone 8¼ lb.) The breasts were undeveloped, and there was an absence of axillary and pubic hair (*Fig.* 40). Mentally she was alert and normal.

In the course of routine examination the differential blood-count was noteworthy owing to the great increase of the eosinophils, which raised in the mind of the pathologist a suspicion of the presence of intestinal parasites.

The white blood-cells were as follows: polymorphs 22, lymphocytes 59, large mononuclear cells 5, eosinophils 14; poikilocytosis marked; no nucleated red cells.

Infantilism has been defined as " an anomaly of development characterized by the persistence of the morphological characters of childhood in an individual who has reached or passed the age of puberty " (Zundel). It is not surprising to find infantilism associated with polyposis of the colon, but so far as can be ascertained this is the only case on record.

Apart from the so-called idiopathic infantilism, and the infantilism due to general diseases such as syphilis and tuberculosis, and that form associated with the internal secretion of abnormal glands, chronic diarrhœa from various causes appears to be responsible for the condition in the majority of cases.

Byrom Bramwell[1] calls attention to infantilism of pancreatic origin in which diarrhœa is the prominent symptom, and it is interesting to note that such cases are cured by the administration of pancreatic extract.

Moorhead[2] reviews the literature and discusses cases of infantilism — pancreatic and intestinal. After a very complete description of a post-mortem on a girl of 18, this latter writer states: " To sum up, the apparently primary pathological change in this case was catarrh of the colon and probably also of the small intestine, and in consequence one may regard the case as one of undoubted intestinal infantilism ".

FIG. 41.—Mucous membrane of the excised pelvic colon studded over with polypi.

In the case under review the polypi invaded the rectum and could easily be prolapsed, but it was only during the course of two operations that they were found to extend upwards through the descending colon and transverse colon, and probably into the ascending and cæcal segment. Proctoscopic examination in this, as in the first case mentioned, was unsatisfactory; it was impossible, after passing through an area of polypoid mucous membrane, to obtain a clear visual field owing to the presence of pus, mucus, and blood.

FIRST OPERATION.—March 3, 1925. The sphincter was dilated. The mucous membrane of the rectum was easily extruded, and was found covered with small polypi. The mucous membrane was raised from the submucous coat by injections of novocain and adrenalin, and a wide cuff was removed,

isolated polypi were cauterized, and the divided mucous membrane was sutured end to end.

The interior of the bowel could be reached to a high level; but at the conclusion of the operation polypi could be felt still higher with the tip of the finger.

SECOND OPERATION.—June 20, 1925. The pelvic colon was exposed through a left paramedian incision. A loop was opened for exploration, and the mucous membrane was found covered with polypi. The loop was mobilized, and the limbs were sutured in parallel fashion and fixed to the abdominal wall by the method of Mikulicz. The extruded portion, measuring 8½ in., was removed after a few days with the cautery. Numerous polypi

FIG. 42.—Polypi extruded through the colostomy after partial colectomy.

were found on opening the portion removed, but they were not diffuse, and the infiltration and loss of flexibility found in the first case were in consequence absent (*Fig.* 41). A finger passed into the lower limb could detect no trace of further growths; but on examining the upper limb pedunculated polypi could be felt as high as the splenic flexure.

In a few days numerous polypi appeared through the upper limb of the colostomy wound, and were removed with the cautery. A week later, further polypi were extruded and removed in the same way (*Fig.* 42). After an interval of some weeks capillaries containing radium emanation were inserted in the end of a rubber tube and passed through the colostomy to as high a level as possible. The tube was removed little by little so that the emanation would be brought into contact with a wide area of mucous coat. Finally, all

trace of blood disappeared, and the colostomy was closed by crushing the spur and the introduction of a few sutures.

In January, 1926, the mother reported that the child was progressing well; she had put on nearly a stone weight and had grown one inch in ten months. Bleeding and diarrhœa had ceased.

In March, one year after the commencement of treatment, the blood-count approached normal. Eosinophils had fallen to 1 per cent, polymorphs had risen to 75 per cent, large mononuclears 15 per cent, lymphocytes 9 per cent. Pubic and axillary hair had appeared, and there were further signs of general development.

PATHOLOGICAL REPORT.—All polypi appear in section as simple adeno-papillomata. No sign of malignancy.

DISCUSSION.

Proctoscopic and X-ray examinations in the two cases under review were of little avail in making a diagnosis. In the first case the rectum and lower portion of the pelvic colon were unaffected, and above this level the field was obscured by fluid fæces, mucus, and blood. X rays confirmed the clinical picture of ulcerative colitis, and later showed the ileocolostomy, but did not go further. In the second case multiple polypi were present in the rectum. Numbers of them attached to a prolapsed mucosa could be protruded through the anus. The field of vision in this case was also obscured when the proctoscope was further introduced along the polypi-bearing mucosa. Barium given through the colostomy opening was not retained sufficiently to give a satisfactory X-ray picture. Reliance is, however, placed on these two methods of examination by Struthers and other authorities. Struthers[3] opens a most illuminating paper by alluding to Röntgen-ray examinations and the diagnosis of multiple polypi before operation or death.

All authorities are agreed as to the association between ulcerative colitis and polyposis, and in this connection the possibility of chronic ulcerative colitis in children should be borne in mind. In the second case the symptoms of colitis appear to have commenced at about the age of 10.

Helmhotz,[4] in recording five cases, the average being under 10 years, says he has failed to find a single article on the subject of this condition of ulcerative colitis in childhood. He thinks it was the terminal stage of ulcerative colitis of adults which was described by Rokitansky, Virchow, and others as polypi of the colon. According to some authorities the origin is congenital, and others lay stress on the familial type.

Pennant,[5] commenting on the first case I have mentioned in this paper, describes the post-mortem on a case of polyposis of the colon. The patient's brother was admitted six months later to hospital with a malignant growth in the left iliac fossa. A colostomy was performed, and the colon was found loaded with polypi similar to those found in the colon of his brother. A third brother came to visit him in hospital, and complained of the frequent passage of blood in the stools. The mother died of cancer at an early age, and a sister of carcinoma of the uterus at the age of 24.

There are many references in the literature to intestinal polyposis. Hewitt and Howard,[6] of Cleveland, refer to cases published as far back

as 1721, 1832, 1839, and 1861, and two more recent cases recorded in 1905 and 1913. The formation of polypi following chronic ulcerative colitis is emphasized. The following cases are mentioned as illustrative of many interesting points :—

A woman, age 36, under the personal observation of Hewitt and Howard, in about the year 1905, had been afflicted for a considerable time with severe diarrhœa, and died in hospital a few weeks after admission. At the post-mortem examination the only lesion of importance found was in the colon. Here the entire mucous membrane, from the ileocæcal valve to the rectum, was uniformly deeply ulcerated, with ragged tags of mucosa scattered widely.

A second case, a man, age 40, was admitted to the Cleveland City Hospital in 1913. Diarrhœa was again the outstanding feature ; the temperature was variable, but never above 101°. The patient died in hospital. At post-mortem examination, the mucosa of the lower two-thirds of the ileum was injected, œdematous, and its surface covered with a thin, greyish layer of exudate. In the lower portion of the ileum, near the ileocæcal valve, and in the cæcum, there were single ulcers, which are minutely described. On the base of several of the largest ulcers there were attached islands and tags of mucosa and submucosa. The wall of the mucosa was thickened, rather fibrous, and stiffly flexible. In the ascending and transverse colons there were many small tufts of mucosa attached by slender pedicles easily detached by passing the finger over the surface. Just above the sigmoid flexure there were a few small polypoid projections ; they were stubby and attached by a relatively thick pedicle ; and, above this again, there was a cluster of large and long polypoid masses. The sigmoid flexure itself was the site of many projections, becoming more numerous as they extended downwards to the external sphincter, but in all there were not more than forty such projections.

Hewitt and Howard thought, from a study of these two cases, that the islands and tags of mucosa and submucosa had been the source of the polypi, which appeared to depend for their preservation on the blood-vascular arrangement, for it was noted that the polyps in the rectum were situated along the side of the intestinal wall, while higher up and in the colon the polyps were situated along the line of attachment of the mesentery, an arrangement that coincides with the blood-supply of the parts.

It is assumed that the beginning of the disease is a general ulcerative colitis. The ulcerative process is of such a character that portions of the mucosa and submucosa adjacent to the primary arterial branches are preserved, and these portions remain as ragged tags scattered over the surface of the colon. As the ulcers heal, these tags become smoothed off, and remain as rounded sessile elevations, or as polypoid projections of the mucous surface. Later on, as cicatrization proceeds, the orifices of certain of the tubules situated in and between the polyps may become occluded, and retention cysts form, giving rise to what Virchow called 'colitis polyposa cystica'. It is the end-stage of colitis polyposa. By some authorities a subtle distinction is made between adenomata, papillomata, and true polypi ; but it appears likely that one is but a stage in the development of the other.

In the *Proceedings of the Royal Society of Medicine*, 1914, cases are recorded by Ivor Back, Gordon Watson, Norbury, and Furnivall.

Back's patient was a girl, age 24. The condition was diagnosed, microscopically and clinically, as carcinoma of the rectum. A colotomy was performed, and adenomata were found extending up into the transverse colon, and they subsequently bulged through a colotomy opening. About a

year later she put on weight rapidly, and the polypoid excrescences had disappeared from the rectum and from the region of the colotomy wound.

In Gordon Watson's case there were numerous œdematous polypi throughout the large intestine, with carcinomatous change in the sigmoid flexure. After resection of the sigmoid the patient ultimately died of hæmorrhage, and secondary growths were found in the lumbar glands and the liver.

Norbury's case was one of multiple polypi of the rectum and colon, with prolapse of the bowel. The rectum and pelvic colon were studded with small sessile polypi which were afterwards found to extend as high as the descending colon. Fixation of the bowel to correct the prolapse, with appendicostomy, was the operation performed.

In a discussion which followed, Lockhart-Mummery said that he believed that the only satisfactory treatment for these cases was complete excision of the entire colon after an ileorectostomy.

The late J. B. Murphy[7] recorded a case of polyposis of the sigmoid, and says that the etiology of intestinal polypi, like that of the common wart, is shrouded in mystery. Whence they come, how they go, is like the riddle of the Sphinx. Quoting Carroll, of the Mayo Clinic, he says that intestinal polyposis is a comparatively rare disease. Polypoid growths may occur at any point along the gastro-intestinal tract; but in the majority of cases they are found in the large intestine, usually at its turning points, and in the rectum. A diagnosis can be made only when the polypi are seen or felt. In Murphy's case the microscope showed adenoma with suspicious areas of active cellular proliferations.

Lockhart-Mummery[8] describes a case of complete resection of the large bowel for multiple adenomata. Numerous adenomata were found in the rectum and sigmoid which extended as high up as the cæcum and all through the transverse colon. The specimen showed multiple adenomata of a simple character throughout the entire large intestine.

Struthers[9] illustrates two specimens which appear almost identical with the specimen illustrated in *Fig.* 39, but in both his cases an adenocarcinoma was found in the rectum. He gives an excellent review[10] on what he calls "multiple polyposis of the gastro-intestinal tract". Eighty-four cases in all are considered, two of which showed multiple polypi in the small intestine, an extremely rare condition. The various portions of the gastro-intestinal tract involved, according to this writer, are as follows: stomach, 4 cases; cæcum to the rectum, 3; rectum and sigmoid, 2; hepatic flexure and small intestines, 1; small intestines, 1; transverse colon, splenic flexure, and descending colon, 1; descending colon and sigmoid, 1.

Cope[11] publishes one case of multiple papillomata of the small intestine causing recurrent intussusception in an adult; and Mills[12] reports a case of multiple polypi of the stomach, a condition which is generally regarded as of great rarity.

The question of ultimate malignancy is discussed, and Lockhart-Mummery is quoted as having said that almost all recorded cases of multiple polypi of the colon eventually became malignant, and that this was the factor to be reckoned with in treating these cases.

Erdmann and Morris[13] state that the disease has a marked predilection

for the male sex, but this statement is not borne out by a reference to the published cases. Attention is called by these writers to the fact that the adenomatous type of polypi is most frequent in the large intestine, usually in a multiple and widely disseminated form. The malignancy incidence they state is 43 per cent (Soper).

Soper[14] calls attention to the fact that "comparatively few cases of multiple polyposis of the colon are reported in literature". He analyses the grand total of 61 cases, and calls attention to the tendency for the growths to occur in the same family. A case is described (the second on record) in which the entire colon was successfully resected for polyposis.

In view of the distribution of the polypi in *Case* 1, it is interesting to note that, according to Soper, the rectum and sigmoid are involved in 95 per cent of all cases of polyposis of the colon. He thinks that sigmoidoscopic examination is the only means by which an accurate diagnosis can be made.

T. S. Swan[15] resected a portion of the transverse colon by the Mikulicz method for the removal of a papillary adenoma. The diagnosis was made by exploration. Diarrhœa with the passage of blood was the outstanding symptom.

CONCLUSIONS.

1. There is a close association between ulcerative colitis and polyposis. Ulcerative colitis occurs in children as well as in adults.

2. The majority of cases sooner or later become malignant.

3. A condition of infantilism may result from polyposis of the colon in early life.

4. Polyposis of the colon cannot be diagnosed unless the polypi are seen or felt. Satisfactory X-ray and proctoscopic examinations are only possible in a proportion of cases.

5. When multiple polypi of a very diffuse nature are present in the colon there is a characteristic infiltration and want of flexibility in the walls which is unlike any other pathological condition. When handling the colon the increase in weight is very striking.

6. The prognosis is bad unless colectomy is performed. Ileostomy, cæcostomy, or appendicostomy, followed by irrigation, has been successful in a few cases.

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DUODENAL ILEUS.

By JOSEPH E. ADAMS, London.

My attention was first directed to this condition by the American literature on the subject. It has been claimed that the chronic form can be recognized on clinical grounds by observation of a dilated duodenum seen through the abdominal wall and by local tenderness just to the right of the umbilicus. In this country D. P. D. Wilkie gave an admirable account of the condition at the Meeting of the Association of Surgeons in Edinburgh in 1921, and his paper was published in the British Journal of Surgery.[1] During the past five years I have been on the look-out for such cases, and wish to place on record the five which I have had under my care.

The American view seems to be that it is a condition with a well-defined individuality, whereas Wilkie regards it as one of the manifestations of general visceroptosis. For my own part I do not claim to be able to diagnose it without the assistance of radiography, but I do not feel convinced that visceroptosis is necessarily present. Its relationship to acute gastromesenteric ileus, or acute dilatation of the stomach, which is an occasional unfortunate sequel of almost every type of operation, is a question to which Wilkie pays great attention, and herein lies the particular value of his paper. He asks three very pertinent questions—namely: "(1) Does a chronic obstruction of the duodenum from mesenteric compression never occur? (2) If it does occur, does it give rise to no recognizable clinical picture? (3) May it not be the precursor of the acute post-operative condition?"

I think the answer to the first question is that operation may reveal a dilatation of the duodenum which definitely ceases at the point where the mesenteric vessels cross over it. The second suggestion seems to be true if we include radiographic evidence in the clinical picture. As to the third point, Wilkie himself brings forward very positive evidence, and it would appear to offer an attractive explanation of the fact that what used to be called acute dilatation of the stomach also includes dilatation, sometimes very considerable, of the first three parts of the duodenum, and never of the fourth part beyond the mesenteric vessels.

The obvious difficulty in accepting chronic duodenal ileus as a clinical entity is the fact that compression of the duodenum by the mesenteric vessels is likely to be a congenital defect, whereas the symptoms are rarely manifest before the age of twenty. The cumulative effects of visceroptosis may be claimed as the determining factor in the causation of the symptoms. If this is so, a complete X-ray examination of the intestinal tract should demonstrate the presence of visceroptosis in all, or nearly all, cases of duodenal ileus. This has not been my own experience, and three out of the four more or less chronic cases herewith considered did not exhibit general visceroptosis. Gastroptosis, on the other hand, was present in three out of the four cases,

and the stomach was flaccid and low in position. In two of them, operated upon on the same day, the state of affairs was so similar that when the second abdomen was opened it looked as if we must be dealing with the same patient all the time. The most striking anatomical feature of these two cases was the fact that the pyloric vein, which encircles the bowel and affords a definite landmark between stomach and duodenum, was seen to be *horizontal.* This was observed as soon as the peritoneal cavity was opened and before anything had been touched, and I think it may afford a further suggestion as to the etiology of the condition. Normally, the pyloric vein is placed vertically, and the first part of the duodenum is horizontal, or nearly so. If the stomach, especially its greater curvature, be dragged downwards, it is easy to see that the pyloric vein may be rotated so that it becomes horizontal. The first part of the duodenum will tend to become vertical. If this drag, originating in the stomach and due to its ptosis and dilatation, be communicated to the duodenum owing to incomplete fixation of its first part, it will pull the duodenum like a cord on a pulley around the head of the pancreas, and the next drag will be exerted where the duodenum is most fixed, namely, at the duodeno-jejunal flexure. The duodenum on the proximal side of this lies behind the root of the mesentery with its contained vessels; thus it may be impossible to differentiate between a dilatation which starts in the stomach and one which is due to the pressure exerted on the last portion of the duodenum. In several of my cases a very striking feature was the displacement of the head of the pancreas as if it had been pulled forward out of its bed, and this, I suggest, would result from such a duodenal pull as I have outlined. (*Fig.* 43; cf. *Fig.* 44.)

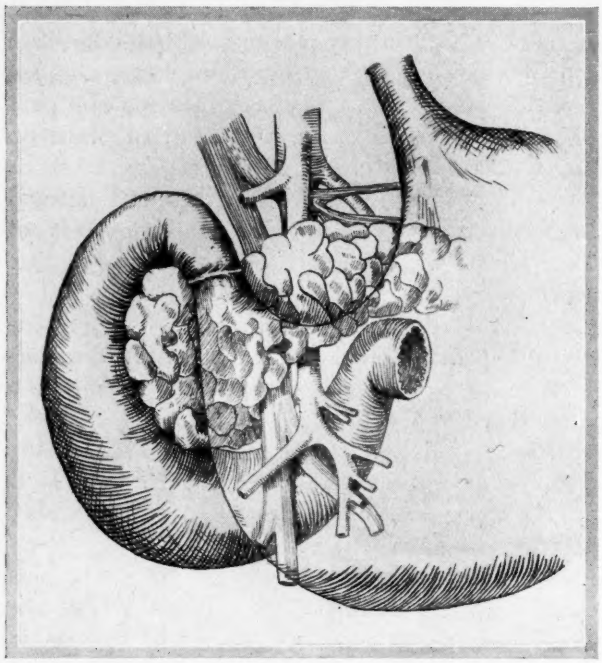

FIG. 43.—To illustrate ptosis of the stomach communicated to the duodenum. First part of duodenum pulled down to a vertical position; pyloric vein horizontal; duodenum pulled round head of pancreas as a pulley; head of pancreas displaced forwards: dilatation of first three parts of duodenum; no constriction by superior mesenteric vessels.

What is really wanted, if mesenteric vessel pressure is to be accepted as the causative condition, is dilatation of the duodenum without dilatation of the stomach. This was present in the third case of my series. That acute dilatation of the stomach was recognized long before the term acute gastro-mesenteric ileus was substituted for it lends colour to the view that the

dilatation of the stomach is commonly the primary lesion. The result of the pull of a dilated stomach, in the absence of pyloric obstruction, must depend on the fixity or otherwise of the first part of the duodenum. If this is anchored in the usual fashion, the dilatation cannot readily be communicated to the intestine; but my experience of these cases shows that the first part of the duodenum is loosely supported, and therefore the direction of the pyloric vein is easily altered. It is dragged down to occupy a horizontal position, the first part of the duodenum becomes vertical, and the rest of the duodenum, with the exception of its fourth part, becomes progressively involved in the distention. In cases of acute dilatation it has been observed that only the first part of the duodenum may be involved, and this may be explained by the fact that death had supervened before full dilatation occurred.

In other cases, where the examination has been made on the post-mortem table, the dilatation involves the duodenum as far as the point of crossing of the superior mesenteric vessels. Surely this is the last phase, when death has occurred late. If it be true that duodenal obstruction is particularly dangerous because of the special toxicity of the duodenal contents, one would expect fatal cases to be discoverable where the vessels had obstructed the duodenum, with, as yet, an undistended stomach. As far as I am aware, such cases are not met with.

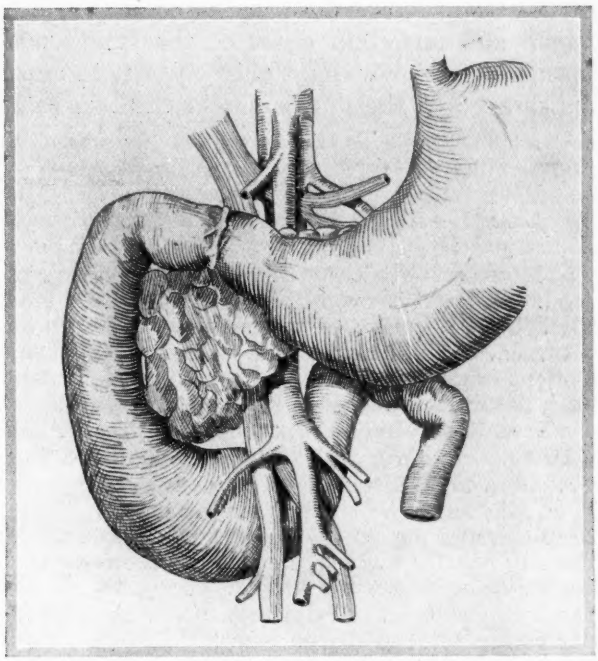

FIG. 44.—To illustrate ileus of the third part of the duodenum from pressure of the superior mesenteric vessels. Stomach, first part of duodenum and portion of second part and fourth part of duodenum, and jejunum entirely unaffected; pancreas not pulled forwards; pyloric vein vertical; first part of duodenum horizontal.

Acute Gastromesenteric Ileus.—The ordinary type of acute gastromesenteric ileus was well exemplified by a fatal case in my own ward nearly two years ago, the details of which are as follows:—

Female, S. B., age 37. Admitted in May, 1923, with a history of dyspepsia for several months and three weeks' persistent vomiting. Fullness of abdomen has increased day by day. Can only take fluids. Very emaciated. Stomach obviously occupying the whole of the abdomen. In a very feeble state.

Treated by lavage and posture and injections of pituitary. Stomach reduced to level of umbilicus, with visible peristalsis. Died rather suddenly thirty-six hours after admission.

POST-MORTEM.—Emaciated body. Heart and lungs normal. Stomach enormous,

reaching to level of the pubes. Duodenum also dilated to the point where mesenteric vessels cross it. *Head of pancreas pressed forward.* No obstruction in duodenum, and no ulcer of stomach or duodenum. Mesentery of small intestine abnormally long and thin. No definite visceroptosis.

Unfortunately, no special observation was made at the necropsy as to the direction of the pyloric vein, but the displacement forward of the head of the pancreas did call for very special comment. The absence of any marked visceroptosis is also important.

The other cases I have encountered belong to the chronic class, although the length of history was a very variable one, and it is most difficult to estimate when the duodenal ileus actually began to occur, for if ptosis and dilatation of the stomach are the primary condition, it is reasonable to expect a rather vague and uncertain onset of the symptoms. In one case indigestion had been present for at least thirty years, in another only three months, yet the appearance of the duodenum in the two cases was precisely similar.

CHRONIC DUODENAL ILEUS.

Case 1.—A. B., male, age 40, pencil maker. Admitted April 30, 1924; discharged May 10, 1924.

History.—At least ten years' history of pain one to one and a half hours after food. Relieved by vomiting, made worse by food. Very little pain when on light diet. Had a course of treatment in medical ward in 1921. Pain has gradually returned. It was troublesome at Christmas, 1923, and has been getting worse since. Patient brings up a good deal of fluid, which is not acid in character, and is troubled with flatulence. Appetite poor. No hæmatemesis. No history of venereal disease. Underwent a successful operation for piles in March, 1922.

On Admission.—A fairly well nourished man, with teeth in good condition. Tongue a little furred. Fauces clean. Abdomen not rigid at any point, and only markedly tender when the pain is present. There is, however, slight tenderness on deep pressure just to the right of the umbilicus. No 'pressure paradox' found. A dilating powder was given and showed clearly the outline of the stomach, its upper border being about the level of the umbilicus and the greater curve low down in the hypogastrium. Ewald test meal: Free HCl, 0·058 per cent; combined, 0·040 per cent; total, 0·098 per cent.

X-ray Report.—Low hypotonic stomach. Peristalsis not very active. Pyloric antrum irregularly filled. Duodenum dilated and persistently filled in all parts. After four hours, persistent shadow still present in the duodenum. Considerable gastric residue. No evidence of ulcer. Condition suggests duodenal ileus.

Operation.—May 15, 1924. Right paramedian incision. Pyloric vein horizontal. First part of duodenum vertical and dilated. Some adhesions between gall-bladder and duodenum at the junction of its first and second parts. Second and third parts of the duodenum very dilated, three-quarters of the lumen of the duodenum in its third part being below the level of the attachment of the transverse mesocolon. Jejunum small, with apparent compression at the duodenojejunal flexure by the superior mesenteric vessels. The mesentery appeared to drag at this point, but there was no general visceroptosis. The stomach was flaccid, and low in position. The head of the pancreas projected forwards within the circle of the dilated duodenum. The adhesions mentioned above constituted an obstruction at the junction of the first and second parts of the duodenum, and therefore it was decided to treat the case by doing a posterior gastro-enterostomy.

Post-operative History.—With the exception of slight pulmonary infarction the result was very satisfactory, and the present condition of the patient is good. A skiagram taken in February, 1925, showed no residue in the duodenum.

Case 2.—L. F., male, age 23, clerk. Patient was of marked neuropathic tendency, a confessed chronic masturbator, anæmic, and depressed.

HISTORY.—Pain in the epigastrium for three months, usually half an hour after food. Sensation of heaviness below the left costal margin, relieved to some extent by light diet and rest in the recumbent position. Intensity of pain proportional to amount and solidity of food. Vomited only once, three weeks before admission, one hour after breakfast. Pain not relieved by this. Suffers from chronic constipation.

ON EXAMINATION.—Tongue coated, breath fœtid. Abdomen tender in epigastrium below left costal margin and ½ in. to the left of the middle line. Slight rigidity of upper part of left rectus muscle. No cutaneous hyperæsthesia. Slow pulse of low tension. Urine: 1010, acid; no albumin or sugar. Ewald test meal: Free HCl, 0·135 per cent; combined, 0·036 per cent; total, 0·171 per cent.

X-ray Examination.—Large hypotonic stomach, emptying rather slowly. Duodenal cap normal. Transverse segmented shadow shows some retention in third part of duodenum, interpreted to mean duodenal ileus.

OPERATION.—May 15, 1924. Right paramedian incision. Pyloric vein horizontal. First part of duodenum vertical and adherent to neck of gall-bladder. Duodenum dilated, especially in its third part, which lay entirely below the level of the transverse mesocolon. No ulcer in the duodenum or stomach. The latter was flaccid and low in position. The first part of the jejunum was normal, and the appearance suggested compression of the superior mesenteric vessels. There was evidence of a drag on the mesentery of the small intestine. The appendix was slightly adherent and was removed. The cæcum and ascending colon were mobile. There was no Lane's band, but a well-defined Jackson's membrane was present. The hepatic flexure was low in position, and a cholecystoduodenal fold was seen.

Treatment consisted in a vertical duodenojejunostomy, and the digestive symptoms were promptly relieved.

POST-OPERATIVE HISTORY.—About a week after the operation the patient developed mental symptoms, and began to decline food, because he always wanted something different from the hospital diet provided. Fortunately this phase did not last long, and when last seen, early this year, he was in excellent physical condition, with good appetite, free from pain, and taking a renewed interest in his work.

Case 3.—E. L., male, age 50, lamp attendant. Admitted June 9, 1922; discharged Sept. 9, 1922.

HISTORY.—Had pleurisy in London Fever Hospital twelve years ago; ill for three months.

For thirty years had had indigestion of intermittent character; worse during the last few years, especially in cold weather. Pain comes on one to one and a half hours after food; is felt at umbilicus and towards right iliac fossa, and then round the *left* loin, as if a cord were tied round patient at level of left costal margin. These pains come on three or four times a week, and are relieved by vomiting. The vomit contains bile and is greenish in colour. No hæmatemesis. Chronic constipation for thirty years. No melæna. Careful in diet since Christmas, 1921. Some loss of weight. Symptoms during this time have grown worse.

ON EXAMINATION.—Thin, wasted man. All teeth have been extracted except one upper left molar stump. Tongue clean. Pharynx normal. Abdomen rather distended all over; some visible veins on abdominal wall; tender around navel, and more definitely so when firm pressure is applied 2 in. inwards from the left anterior superior spine. No mass palpable anywhere. Urine, nil. Chest, nil. Central nervous system normal. Ewald test meal: Free HCl, 0·091 per cent; combined, 0·040 per cent; total, 0·131 per cent.

X-ray Examination.—Fair residue in stomach after six and a half hours. Second meal shows stomach low in position, with good tone. Feeble peristalsis, and deformity at pyloric end. Partial obstruction at or near the duodenum.

On June 21 there was no pain in abdomen, but a good deal of flatulence and eructation. There was some pain on micturition, attributed by patient to the flatulence. Muscular cramps in legs below knees.

OPERATION.—June 28, 1922. Right paramedian incision. Stomach normal, and pylorus normally placed. First and second parts of duodenum only slightly dilated. Marked dilatation of third part of duodenum seen below transverse mesocolon. Commencement of jejunum narrow. Difference due to pressure of superior mesenteric vessels and extra folds of peritoneum, with obvious drag on root of mesentery. Appendix distorted and adherent in proximal third. Catarrhal changes. Treated by vertical duodenojejunostomy with catgut.

POST-OPERATIVE HISTORY.—Rather severe pain for two days after operation, but then well until July 17, when he began to have thrombosis in the left femoral vein. (This leg was infused with gum during operation.) *No digestive trouble.*

July 14.—Barium meal. Patient examined in bed (semi-prone). Stomach lying well to the left. Duodenal cap not filled; after one and three-quarter hours very little had left stomach; after four hours stomach quite empty. No residue in any part of duodenum.

July 25.—Got up, but fainted and had to be put back to bed. *Enjoys food.*

July 31.—Pain of stabbing nature felt in right shoulder on inspiration present the last two nights.

Aug. 3.—Distinct pleurisy in right side, followed a fortnight later by similar trouble at left base; no effusion occurred on either side, but some crepitations were heard. Did not spit up any blood.

Discharged in good condition. No abdominal symptoms when seen subsequently on Sept. 11, 1922.

Reply to letter of inquiry March 17, 1925: "At work and greatly improved though not robust. Has to be careful as to diet."

Case 4.—P. C., male, age 42, labourer.

HISTORY.—Indigestion and pain in the epigastrium for seven years. Marked loss of appetite and occasional regurgitation of food. Twelve months before admission had a severe attack of epigastric pain, with vomiting, which lasted for eight hours. Never quite free from pain since; always epigastric in position, usually severe in character, with brief intermissions. Attacks of greater pain used to occur weekly; now they come on daily and even four times in the twenty-four hours. Nearly always followed by diarrhœa. Patient is sometimes doubled up with pain, and then fluid passes up into the mouth, and stomach feels as if dragged upon. Pain rather more in the right than the left half of the epigastrium. Worse as the day passes, and aggravated by food. The pain does not keep patient awake at night. There has never been hæmatemesis or melæna. No history of jaundice. Pain at its maximum one hour after food.

ON ADMISSION.—Slight tenderness in right half of epigastrium with some hyperæsthesia. No paradoxical sign. Ewald test meal: Free HCl, 0·0766 per cent; combined, 0·0511 per cent; total, 0·1277. Barium meal: Six and a half hours after first meal residue in stomach and first part of duodenum, the latter lying alongside the hepatic flexure and inseparable from it. Second meal shows gastroptosis with pyloric end of stomach drawn over to the right. Duodenal cap dilated but with a clear outline. Emptying very slow; cannot be assisted by manipulation.

OPERATION.—July 3, 1925.—Right upper paramedian incision. Stomach greatly dilated and low in position. *Pyloric vein vertical.* First part of duodenum 3½ in. in diameter and firmly adherent to gall-bladder at junction of first and second parts. No ulcer of stomach or duodenum. Second part of duodenum 2½ in. across. The adherent gall-bladder probably prevented rotation of the pyloric vein, and the first part of duodenum remained horizontal instead of becoming vertical. Third part of duodenum distended to width of three fingers below the attached transverse mesocolon. Jejunum normal in size. No clear evidence of dropped mesentery obstructing the fourth part of the duodenum. Head of pancreas not displaced forwards. Treated by vertical duodenojejunostomy.

POST-OPERATIVE HISTORY.—Patient did very well after operation until September, when he had to be operated upon in a hurry for acute small-bowel obstruction due to a band resulting from the first operation. He has made a good recovery from this.

A consideration of the clinical aspect of these cases does not lead to the conclusion that the diagnosis can be made with any degree of certainty without the aid of radiography. Kellogg,[2] on the other hand, claims to be able to diagnose the condition by a scrutiny of the history and physical examination of the patient. If only the first part of the duodenum is involved, the case resembles pyloric obstruction, but in the true complete cases symptoms are partly toxic and partly mechanical: headache, depression, cold extremities, with pain or dull ache just above and to the left of the umbilicus—presumably at the duodenojejunal junction—or pain to the right of the middle line beneath the liver, passing through to the back. The pain is often relieved by pressure, but in some cases only by vomiting. The vomit in these cases usually contains bile. Hayes[3] speaks of two physical signs as characteristic: (1) Tympanites beneath the upper right rectus in the region of the pylorus associated with gastric retention; and (2) The 'pressure paradox'. This is exemplified by the effect of upward and backward pressure by the hand just below the umbilicus for half a minute. This will enable gas to escape past the duodenojejunal kink, relieve the distention, and therefore lessen the tympanites in the pyloric area. Gas may be heard or felt to gurgle through the constriction beneath the hand, and pain disappears. Kellogg has verified these signs, but he admits that there may be fallacies, since the duodenum may not be distended at the time of the examination, whereas the colon or stomach may be distended. Furthermore, who shall say that the distention is that of the duodenum itself? Such an accurate observation appears to me to demand too high a capacity for any ordinary clinician. The pressure paradox sounds convincing, but I have failed to demonstrate it in my cases even after the diagnosis was made by the radiologist. It would seem more reasonable to state, as Moynihan has with regard to gastric ulcer, that the only two persons who can make the diagnosis with certainty are the radiologist and the surgeon, and the latter can only do so after the abdomen is opened. The condition may be apparent at once, and I have already pointed out the importance of the forward displacement of the head of the pancreas and the horizontal position likely to be taken up by the pyloric vein.

Kellogg is of the opinion that only a small proportion of the cases require surgical treatment, but that relief can be obtained by a suitable support for the enteroptosis, which he regards as primary. He also urges the desirability of combining fixation of the hepatic flexure of the colon and cæcum with duodenojejunostomy in those cases where the severity of the symptoms demands operation. Bloodgood[4] has also described cases treated on these lines.

In my own practice I have recently explored the abdomen of a woman whose enteroptosis was associated with ileus certainly affecting the first two portions of the duodenum.

Case 5.—A woman, age 30, unmarried. Since January, 1922, she has had persistent abdominal pain, with loss of appetite but a feeling of want of food. Pain is felt mainly in the epigastrium and right loin, and is not materially altered by the taking of food or dieting. Attacks of nausea, headache, and giddiness are common, but little actual vomiting occurs. In January, 1923, her appendix was removed and some adhesions were divided in the right iliac fossa. This operation gave her

no relief, and I first saw her in July, 1923. At this time she presented rather a miserable appearance, thin, with a raw tongue and low-tension pulse. There was some tenderness in the upper right portion of the abdomen. The cæcum was distended; both right and left kidneys were definitely mobile, but she presented no other physical signs on examination. The bowels were constipated unless she took liquid paraffin. An Ewald test meal revealed: Free HCl, 0·219 per cent; combined, 0·072 per cent; total, 0·291 per cent. X-ray examination gave positive evidence of generalized visceroptosis. I considered that she was not a suitable subject for surgery, and prescribed an abdominal belt to support the prolapsed large intestine. In May, 1924, her general practitioner, Dr. J. A. Clark, of Sittingbourne, reported that she was no better, and about this time she had further trouble owing to the sudden death of her father and the severe illness of a brother. At her earnest request the question of operation was reconsidered this year, and after a further radiographic examination it was decided to explore the abdomen. The determining reason was that the skiagram strongly suggested the presence of a lesser curve ulcer. Two examinations were made, and there was a well-marked persistent spasm on the greater curvature of the stomach, which was J-shaped and hypotonic, with a suggestive shadow of a 'hold up' at a point on the lesser curve. No ulcer, however, could be found at the operation.

The state of affairs presents to my mind an early stage of duodenal ileus, with very little evidence that compression of the last part of the duodenum by the superior mesenteric vessels is an essential causative factor. In the first place the great omentum was adherent to the anterior abdominal wall low enough down to drag on the transverse colon. The stomach was large and flaccid, low in position, and J-shaped, with a vertical pyloric canal and *horizontal pyloric vein*. Its walls were quite healthy and free from adhesions. The first part of the duodenum was almost vertically placed, and at least twice as big as usual. There was no kink at the junction of the first and second parts, and the latter portion was equal to the first part in diameter. As the third part was reached, there was a lessening in size of the duodenum; but on pulling up the transverse colon it was observed that the duodenum could clearly be seen below the level of the transverse mesocolon; its lower border lay about a finger-breadth below the line of attachment of the mesentery. The head of the pancreas was not unduly prominent, but it was easily felt. There was certainly no evidence of collapse of the first part of the jejunum; in fact the bowel at this point was rather large and thick-walled. There was no sign, therefore, of compression by the superior mesenteric vessels, and no drag upon them by the mesentery of the small intestine could be demonstrated. It would, however, have been quite easy to expose the third part of the duodenum and anastomose it to the jejunum. The gall-bladder and bile-passages were normal and no bands passed from the gall-bladder to duodenum or colon. The hepatic flexure of the colon was ill-defined and not secured to the posterior abdominal wall. A very definite Jackson's membrane was present, whilst the cæcum was large, flaccid, and mobile. No Lane's band was found, but there was a well-marked fold producing a kink in the ascending colon just above the Jackson's membrane. Undoubtedly the mobile cæcum and ascending colon could have exerted a pull on the mesentery; but if that was the cause of the dilatation of the duodenum, why should it affect the third portion less than the first and second? In my opinion the drag was exerted on the other end of the duodenum, and I hold that gastroptosis was responsible for the duodenal ileus, the horizontal line of the pyloric vein pointing strongly in this direction. The gastroptosis no doubt was partly due to the downward drag of the transverse colon, which was ill-supported, as well as the loss of tone in the stomach itself.

Treatment was directed to the relief of the mobility of the cæcum and the downward displacement of the hepatic flexure of the colon, together with plastic division of the cæcocolic fold. The Jackson's membrane was not disturbed; but the hepatic flexure and cæcum were sutured with silk to raw areas made in the posterior parietal peritoneum. Had the third part of the duodenum been more dilated, I should also have done a duodenojejunostomy. It will be necessary to

insist on the patient's wearing an abdominal support, and time alone can show whether the right treatment has been adopted. If the result is not satisfactory, I think there will be a clear indication for short-circuiting the duodenojejunal junction. I may mention also that the X-ray examination had not suggested duodenal delay, and, unless this is present, mere dilatation of the duodenum hardly calls for this more drastic operation.

CONCLUSIONS.

1. A consideration of these cases appears to indicate that chronic duodenal ileus may be secondary to gastroptosis alone.

2. In a smaller number of cases it may be due to compression of the fourth part of the duodenum by the superior mesenteric vessels and the drag of the mesentery.

3. It is doubtful how far it is a manifestation of general visceroptosis, but this may be responsible for it.

4. The dilatation of the duodenum, therefore, may affect primarily either the first or the third part of the duodenum.

5. The appropriate treatment in most cases is duodenojejunostomy. In a few cases, however, there is so pronounced a kink at the junction of the first two parts of the duodenum that gastro-enterostomy is likely to give the best results.

I am indebted to my former dresser, Mr. H. E. Blake, for the drawings.

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[2] KELLOGG, E. L., *Surg. Gynecol. and Obst.*, 1919, xxviii, 174.
[3] HAYES, " Intestinal Stasis ", *N. Y. Med. Jour.*, 1914, Jan. 24.
[4] BLOODGOOD, *Jour. Amer. Med. Assoc.*, 1912, July 13.

TWO CASES OF STRICTURE OF THE BOWEL BY MISPLACED ENDOMETRIAL TISSUE.

By T. B. MOUAT, Sheffield.

I venture to describe two cases of stricture of the gut due to invasion of its wall by misplaced endometrial tissue, because most of the previous work on this subject has appeared in journals devoted to gynæcology and obstetrics, and a wider recognition and knowledge of the condition by the general surgeon is desirable, as the lesions set up by these transplantations give rise to difficulty in diagnosis and treatment.

While grafts of true endometrial tissue appear to be derived from the uterine and less frequently from the tubal mucosa, difficulty and much argument have arisen from the possibility that very similar glandular inclusions may, in certain situations, result from developmental abnormalities of certain embryological structures, or from metaplasia of the serous lining of the abdominal cavity, or of the epithelial covering of the ovary in inflammatory lesions of these structures; and Sampson,[1] in view of this difficulty, has proposed the following classification in order to include all possible varieties of the condition.

1. *Direct or Primary Endometriosis*, i.e., misplaced endometrial tissue in the uterine wall which was demonstrated by Cullen[2] and other authors to have arisen from the direct invasion of the myometrium by the mucosa lining the uterine cavity, causing the well known adenomyoma of mucosal origin. A similar condition occurs in the wall of the tube from its invasion by the tubal mucosa.

2. *Peritoneal or Implantation Endometriosis.*—In this group implantation-like deposits of endometrial tissue are found scattered through the pelvis, similar in their distribution to the peritoneal implantations of cancer and, like the latter, often invading underlying structures.

3. *Transplantation Endometriosis*, in which endometrial tissue occurs in the scar of the abdominal incision after operation on the pelvic organs. Sampson states, in discussing this variety, that " he is convinced that the manipulation of the uterus and tubes incident to pelvic operations may at times detach uterine and tubal epithelium and cause it to be transferred not only to the abdominal wound, but also to the tissues of the pelvis. This is particularly true for endometrial tissue if the abdominal operation has been immediately preceded by a curettage ".

4. *Metastatic Endometriosis.*—A group which includes extraperitoneal endometrial tissue in situations similar to the metastases from cancer of the pelvic organs.

5. *Developmentally Misplaced Endometrial Tissue.*—Sampson admits the possibility of such a condition, but states that " he has never been able to appreciate it ".

The following two cases are examples of peritoneal or implantation endometriosis :—

Case 1.—**Implantation endometrioma involving the ileum; resection with end-to-end reunion: adherent tubo-ovarian cyst on right side.**

Mrs. H., age 36. No pregnancies. Complained of pain in the lower abdomen and of severe dysmenorrhœa. Menstruation had always been painful, and it was scanty and irregular up to the time of her marriage in 1911. After marriage she was

ill for some weeks with severe pelvic inflammation, and ever since then the loss has been profuse but still irregular in type (five to eight weeks). For the year preceding operation the dysmenorrhœa had been so severe that she had to lie up for the first day of each period, and she had also suffered from colicky pains in the lower abdomen.

The motions were regular, and there was no constipation or difficulty with the bowels at the periods.

Operation.—June, 1924. The lumen of the ileum was found to be narrowed by a localized puckered depressed area which crossed the antimesenteric portion of the gut at a point about nine inches proximal to the ileo-cæcal valve. The appearance suggested that the lesion was the result of a localized healing tuberculous ulcer. About three inches of the gut were resected, and end-to-end suture with fine linen thread was performed. The appendix, which was kinked and contained a concretion, was removed. On examining the pelvis the left appendages were found to be cystic and firmly adherent to the pelvic floor and back of the uterus. They were freed and removed. It was thought from the history that the pelvic lesion was the result of old gonorrhœal infection, and although on cutting open the specimen it was noticed that the contents were of a dirty brown colour, the only association which suggested itself between the lesion in the gut and that in the pelvis was that as the mucosa of the resected segment of intestine was intact, and its walls were obviously invaded from without, the gut had been adherent to the lesion in the pelvis and had subsequently freed itself.

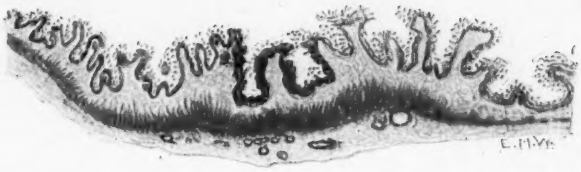

Fig. 45.—Adenomyoma of ileum. Hæmalum and eosin. (× 2.)

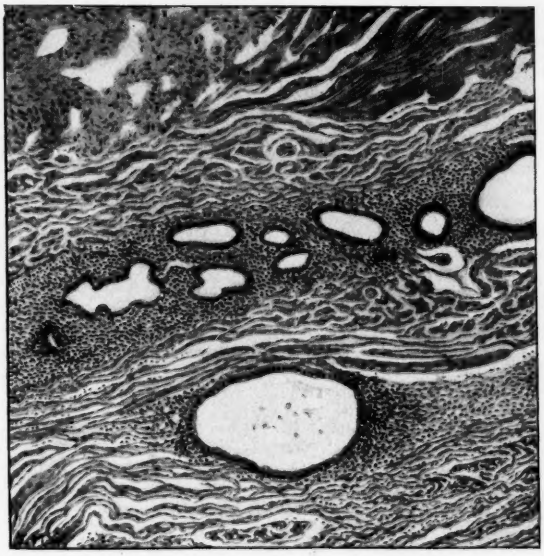

Fig. 46.—Adenomyoma involving ileum. Endometrial tissue in subserosa, muscular coat of ileum above. (Low power.)

The resected portion of the gut was examined by Professor Stewart, of Leeds, who reported that the muscular wall of the gut at the site of the lesion was hypertrophied and invaded from without by groups of glandular acini lined by low columnar epithelium and embedded in stroma of endometrial type (*Figs.* 45, 46).

The patient eighteen months after operation (Jan. 5, 1926) reports that her dysmenorrhœa and pelvic pain are cured. The periods are regular and the loss is not excessive. She has no trouble with her bowels, and is working regularly as a school teacher.

Case 2.—**Perforation of a tubo-ovarian blood cyst which simulated rupture of an extra-uterine gestation. At operation a stricture of the ileopelvic colon was found, and when subsequently resected proved to be an implantation endometrioma.**

Mrs. S. P., 43, one child, age 19½. Her illness dates back to the pregnancy, during which she suffered from 'chronic appendicitis', and ever since she has been troubled with recurring attacks of 'inflammation' in her lower abdomen, for which she used to lie up for weeks at a time. Twelve years ago she was examined by a gynæcologist and told that she had a cystic adherent ovary, for the removal of which

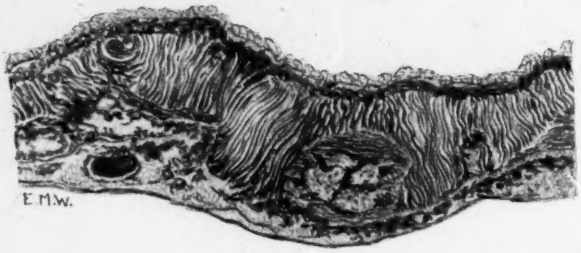

FIG. 47.—Adenomyoma of sigmoid. Masson's trichromic method. (× 2.)

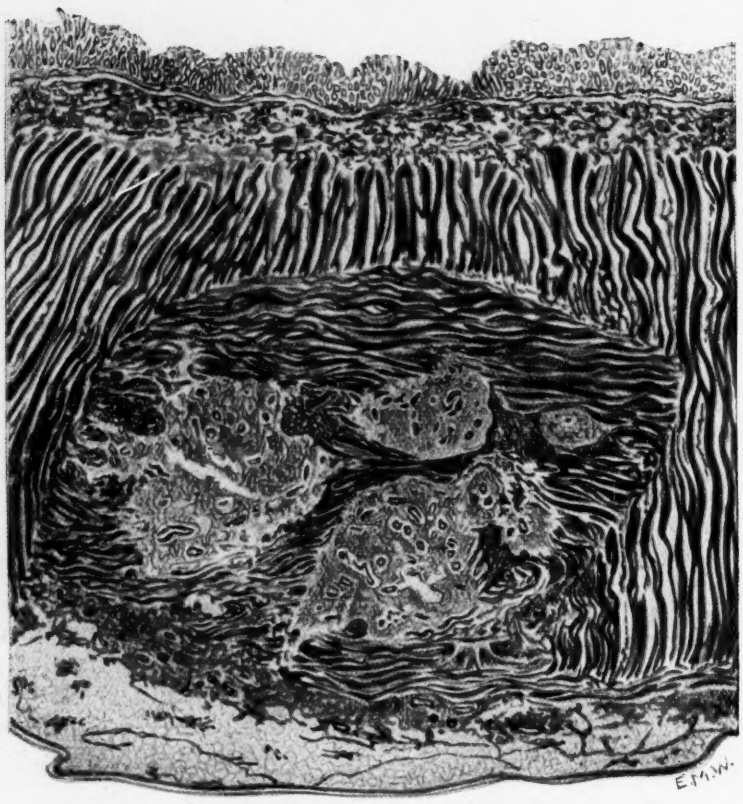

FIG. 48.—Adenomyoma invading sigmoid. Masson's trichromic method.

an operation would be necessary. She was not sent for to go into hospital, and a year later her own doctor examined her, and told her that "her inside had righted itself", and advised her "to let well alone". She carried on in ill health, with attacks of dysmenorrhœa and increasing loss at the periods, till before operation she was losing menstrual blood for three weeks each month, and the dysmenorrhœa had markedly increased for the twelve months which preceded her operation. For some

months she has also been troubled with increasing constipation, and noticed that this difficulty was greatly increased during the first week of each period.

The present illness commenced on Sept. 7, 1925, the second day of her menstrual period, with very severe pains in the lower abdomen and vomiting, and on the following day, when I saw her in consultation, she had a rapid pulse, a temperature of 101°, and dullness and rigidity in the lower abdomen.

OPERATION.—Free blood was seen through the peritoneum before it was incised, and a large amount of brownish-coloured stale fluid blood filled the lower abdomen, and had formed clots in the pouch of Douglas. The left tube and ovary were matted together, and fresh blood was found oozing from what appeared to be a ruptured extra-uterine gestation in the outer end of the tube. The left appendages were removed. No ovum was seen, and the specimen was unfortunately destroyed with the blood-clot. Before closing the peritoneum it was noticed that the apex of the ileopelvic loop of bowel was puckered, and its lumen narrowed by an area of induration and thickening which had all the characters of an early carcinomatous growth invading the wall of the gut.

The patient's condition did not warrant any further interference at that time, but six weeks later (Oct. 17) the abdomen was re-opened, and the affected segment of gut, with about an inch and a half of healthy bowel on either side of it, was excised. On examining the specimen the healthy condition of the mucosa and the limitation of the infiltrating tissue to the outer coats of the gut suggested that we had to deal with an implantation endometrioma and not with a carcinoma of the bowel. The gut was reunited by end-to-end suture with fine linen thread, and a 'safety-valve' cæcostomy was formed. A careful search revealed that no further implantations had resulted from the extensive peritoneal soiling by the contents of the blood cyst.

Recovery was uneventful; the patient has had two periods of three days' duration at twenty-eight-day intervals since the operation; the periods were practically painless, and she has had no difficulty with the bowels.

The histological examination of the specimen showed groups of glandular acini and stroma of uterine type invading the hypertrophied muscular coats; an opinion which was confirmed by Professor Stewart, to whom I am indebted for the beautiful sections stained by Masson's trichromic method and admirably reproduced in Miss Wright's water-colour drawings (*Figs.* 47, 48).

ETIOLOGY OF IMPLANTATION ENDOMETRIOMATA.

This appears to be simplified by the fact that the anatomical distribution of the implantations seems to exclude the earlier theories which ascribed them to aberrations in development of included Müllerian or Wolffian structures; while their sex and age incidence, and their histological and physiological characteristics, are all opposed to their being due to metaplasia of serous inclusions in areas undergoing inflammatory changes, and the most feasible explanation of their occurrence appears to be that advanced by Sampson,[3,4] who first drew attention to the frequent association of these migratory adenomyomata with hæmorrhagic ('chocolate or tarry') cysts of the ovary, and suggested that the grafts of endometrial tissue made their escape from the abdominal ostium of the Fallopian tube during retrograde menstruation.

These migratory grafts select the ovary, but they may also fall into the pouch of Douglas and implant themselves on the pelvic floor, or on any of the pelvic viscera; and while further manifestations of their activity vary with their vitality, they show a general tendency to 'dig themselves in', and may manifest their function by the occurrence of menstrual bleeding into their

substance. The blood cysts which are thus formed in the ovary are very characteristic, and evidence of their former existence and perforation is so constantly associated with more extensive dissemination of the endometrial tissue and invasion of any of the pelvic structures outside the ovary that Sampson in his earlier writings expressed the opinion that additional vitality might be acquired by the grafted tissue during a primary lodgement and growth in the ovary, from which an invasive type of glandular tissue was released on perforation of the blood cyst which had resulted from its activity, just as a colloid or carcinomatous tumour might disseminate its contents under somewhat similar conditions.

Bailey[5] disagreed with Sampson's view that the ovary might act as "an intermediate host, hot bed, or incubator", as his observations led him to believe that the implantations, wherever situated, were approximately of the same age, and resulted from the simultaneous deposition of epithelium of endometrial or tubal origin on the surfaces of various organs, after its escape from the tube during retrograde menstruation. In his view the 'chocolate' fluid contained in the ovarian blood cavity can have no active rôle in disseminating the grafts, because it merely consists of stale menstrual blood, phagocytes, and degenerated epithelial cells which are incapable of further growth.

In any case it is an accepted fact that the ovaries are the common site, their involvement is frequently bilateral (8 of 23, Sampson), and when affected they become embedded in adhesions which involve the pelvic viscera and simulate the results of pelvic inflammation. The stale blood contents of the ovarian cysts, the ragged, pitted appearance of the separated viscera, and the presence of discrete pelvic or bowel implantations, are, however, characteristic of the lesion under consideration.

Of Sampson's[6] 12 cases in which implantations were found in the wall of the bowel, the rectum and sigmoid (including the appendices epiploicæ and mesentery) were involved in 8, the appendix in 4, and the small intestine in 2; and the presence of a blood cyst in the left ovary was noted in 6 of the 8 instances of implantations in the sigmoid and rectum, while they were found in the right ovary in all of the four cases in which the appendix was involved.

My own two cases and the examples recorded by Dougal[7] and Leitch[8] confirm Sampson's suggestion that the portion of the intestine situated near the affected ovary is more likely to be involved.

The lesions which result from the implantation of the endometrial grafts on the bowel vary greatly in character, and range from a tiny serous dimple or opacity to a puckered growth which closely resembles a carcinoma. Leitch (loc. cit.) records an interesting example of this simulation in which at operation "a small puckered area half an inch in diameter was noticed on the antimesenteric border of the most dependent part of the loop of the sigmoid flexure; underneath this area there was a very hard nodule in the bowel wall of the size of a Barcelona nut, which seemed from its appearance, and the sensation it gave to the finger, to be perfectly typical of carcinoma; and such was the opinion of Mr. W. Ernest Miles, who happened to be in the nursing home at the time". Mr. Rowntree subsequently operated on the gut lesion, but "before proceeding to the resection he opened the bowel

beyond the margins of the growth, and found that the epithelial layer was intact. A small portion of the bowel wall was therefore removed, and an end-to-end anastomosis performed ". On microscopic examination the lesion proved to be an implantation adenomyoma of uterine type.

Sampson (loc. cit.) records a similar case in which an indurated area in the sigmoid just below the pelvic brim was found in association with an adherent cystic left ovary. The lesion of the gut was thought to be carcinomatous, and 8 cm. of the bowel were resected, with end-to-end reunion by suture. The tumour proved to be an adenoma of endometrial type, but the ovarian cyst was not examined histologically.

In my second case the apex of the ileopelvic loop of the bowel was puckered, and its lumen narrowed by a transverse depression which crossed the antimesenteric half of the gut, and was surrounded by an area of induration and thickening which closely resembled a slowly growing and retracted carcinoma. The affected part of the gut was not adherent to the pelvic lesion.

In my first case a somewhat similar condition was noticed on the antimesenteric portion of the ileum at a point about nine inches above the ileocæcal valve. The gut was not adherent, and it was somewhat distended above the strictured area. The peritoneum covering the transverse depression was opaque and 'stippled' in appearance, and the lesion was thought to be a localized healing tuberculous ulcer.

In two of Sampson's cases the implantation was similarly situated in the ileum, and a further case was recorded by Clara Stewart[9] in 1920. This marked restriction to portions of the intestinal tract which frequently occupy the pelvis, and the appearance and distribution of the implantations in both my cases, rather suggest that the transference of the endometrial tissue had taken place during some earlier period in which the gut had been adherent to the pelvic lesion.

SYMPTOMS AND PHYSICAL SIGNS.

The symptoms and physical signs of the pelvic lesion may be characteristic, and we are chiefly indebted to Donald[10] and to Sampson for their recognition.

The age incidence is from 30 to the menopause, and the women affected are usually sterile or have borne no children for a number of years, while they generally suffer from acquired and increasing dysmenorrhœa due to the bleeding which takes place into the invaded ovary and pelvic implantations during the menstrual periods. In one of my cases, and in several of the recorded instances of implantation in the bowel wall, a characteristic result of this menstrual hæmorrhage was the occurrence of intermittent obstruction during the periods. Rectal discomfort and tenesmus may only then be present, or are more marked at those times.

On pelvic examination the cystic and fixed ovary may be felt in the pouch of Douglas; while the uterus is fixed, and infiltration of the recto-vaginal septum, and of the wall of the rectum, may be palpable when present.

Where rectal pain and discomfort at the menstrual periods are prominent symptoms, examination with the sigmoidoscope should be helpful, for it would show that the mucosa is not involved in the lesion.

The majority of the grafts tend to die off, and are of histological interest only; but continued activity and progressive infiltration of the pelvic viscera may occur as long as ovarian tissue is present, and Sampson[1] has shown that invasion of the lymph channels may occasionally take place, and might explain the recorded instances[11] in which adenomata of endometrial type have been found in the groin and other situations in which the possibility of implantation and transplantation could be excluded.

TREATMENT.

While in particular instances the local lesions may require direct operative treatment, this is not generally considered necessary, and on recognition of the nature of the implantations the further procedure should be directed against their source in the pelvic viscera. Sampson's usual practice is to remove the uterus and both ovaries and tubes, and to disregard the implantations (including intestinal) except as they may be easily removed for histological study. The ovaries are removed as they are a possible source of further implantations, and because their hormones tend to perpetuate the activity of any heterotopic endometrial tissue; while the uterus is often retroverted and adherent, and myomas or other pathological conditions may be present, which in themselves indicate its removal. He admits, however,[12] that in special circumstances, as, for example, in young women who are anxious to have children, and in whom the disease is not extensive, he would be content with more conservative measures, and on occasion he has excised small endometrial deposits from the ovary. In five instances in which he had done conservative surgery the patients subsequently became pregnant, and three of them had children. He considers, however, that these cases must be followed closely, as undoubtedly in some of them the lesion will recur or progress so that a second operation may be required.

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THE CONTROL OF HÆMORRHAGE AFTER PROSTATECTOMY BY THE USE OF THE INFLATABLE RUBBER BAG.

AN IMPROVED METHOD OF RETAINING THE BAG.

By T. McW. MILLAR, Edinburgh.

One of the dangers of enucleation of an enlarged prostate is hæmorrhage, the bleeding occurring chiefly from the ruptured veins in the walls of the cavity left after the prostate has been removed. Such bleeding may be profuse, and occurring, as it does, in patients who are often in poor condition, it adds considerably to the danger of the operation. In addition, the formation of clots in the bladder sometimes leads to trouble in the post-operative course by blocking the drainage tube in the bladder, so necessitating interference by the surgeon at a time when the patient is best left alone.

Many methods have been devised to control this hæmorrhage, but it would seem that none is so simple, so effective, and so safe as the use of a specially designed inflatable rubber bag, such as the Pilcher bag. This seems to be in common use in America, but British surgeons do not appear to be familiar with it, and the purpose of this communication is to draw attention to the advantages of such a bag, and to suggest a method of retaining it in position which is simpler, more effective, and more comfortable for the patient than any we have seen described.

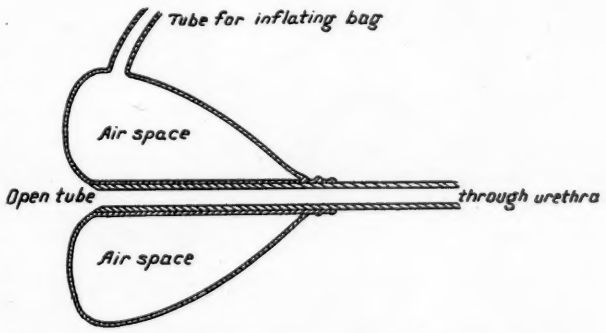

Fig. 49.—Sketch to show structure of the Pilcher bag.

In 1914 Hagner described a simple bag which he had designed and used to control hæmorrhage after prostatectomy, and Pilcher in 1917 modified and elaborated the design. Pilcher's bag is cone-shaped, and has attached to it two tubes, the one urethral and the other inflating. The urethral tube leaves the bag at the apex of the cone, but does not communicate with the cavity of the bag; instead it passes through the bag from the apex to the centre of the base, where it opens—into the bladder when the bag is *in situ*. The inflating tube is attached to the bag near its base, and opens into its interior (*Fig.* 49).

Method of Introducing the Bag.—Before the operation is begun a soft rubber catheter is passed into the bladder per urethram and left in position. The prostate is enucleated in the ordinary way, and the prostate cavity

examined to make sure that the removal has been complete. The end of the catheter is then pulled through the suprapubic wound, and the end of the urethral tube of the bag threaded over it and fixed there by means of a catgut stitch which transfixes both catheter and tube. The catheter is then withdrawn from the urethra, pulling the urethral tube after it. As soon as the end of the latter has emerged from the external meatus, it is disconnected from the catheter, and further drawn upon so as to bring the collapsed bag within the bladder. The bag is now inflated, or distended with sterile fluid by means of a syringe attached to the end of the inflating tube, and when sufficiently distended, as gauged by the surgeon's finger in the bladder, the tube is clamped. Further traction on the urethral tube now draws the bag into the prostate cavity, the surgeon's finger guiding it in and tucking down in front of it the shelf of mucous membrane, or any tags of mucous membrane which formerly covered the vesical surface of the prostate. The urethral tube is now firmly pulled upon, and from that moment onwards, until the risk of further hæmorrhage is believed to have passed, the tension on the tube is never relaxed. From that moment also practically all hæmorrhage ceases. (*Fig.* 50.)

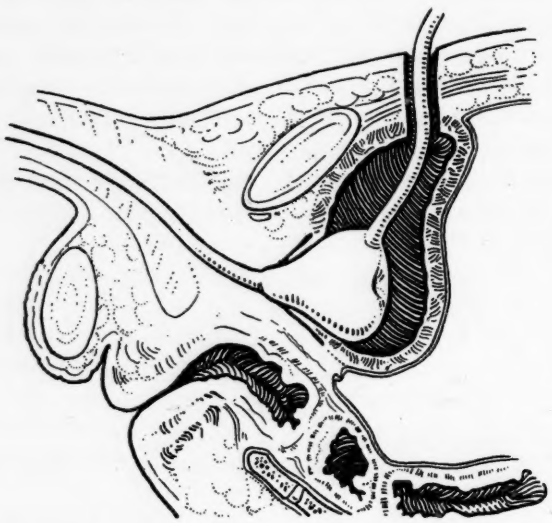

FIG. 50.—Shows the bag in position after removal of the prostate, the urethral tube passing along the urethra, and the inflating tube emerging from the suprapubic wound.

New Method of Retaining the Bag in Position.—When the bag has been inserted as described, there is still part of the operation to be completed, viz., the insertion of the suprapubic drain and the closure of the wound in the bladder and abdominal wall. It is therefore undesirable to remove the sterile towels covering the patient, but at the same time necessary to fix the urethral tube temporarily in such a way as to maintain the tension on the bag. This is simply done by pulling on the urethral tube and stretching it until its end reaches below the patient's knees, where it is clamped to the patient's bed-sock through the sterile towels by means of an artery forceps. The bladder may now be gently washed out, the operation completed, and the dressing applied to the wound. The forceps holding the tube is now removed, the tube is held taut until the towels are removed, and then again clamped to the patient's sock, and the patient returned to bed.

A light weight-extension is now substituted for the fixed extension which has been employed up to this point, a weight of 1 to 2 lb. being applied to the urethral tube by means of a piece of string which passes over the bar at the foot of the bed, or over a pulley, though the latter is hardly necessary. The patient is thus left with the bag fitting snugly into the prostate pouch, and

securely kept there by a weight extension of 1 to 2 lb. exerted along the urethral tube, which passes from the penis down between the patient's thighs, causing him no inconvenience and allowing him to move his limbs freely without interfering with the tube or altering the pull on the bag. From the suprapubic wound there emerges the suprapubic drain, and alongside it the inflating tube, clamped (*Fig.* 51).*

If, after four, six, or eight hours or longer, the danger of hæmorrhage is believed to have passed, the pressure exerted on the walls of the prostate cavity can be immediately removed by disconnecting the weight from the urethral tube. The latter retracts to its normal length and then acts as an extra drain from the bladder, the end of the tube being passed into a urinal. If it is further desired, perhaps after waiting a few hours and no hæmorrhage having occurred, to deflate the bag, this is done by removing the clamp or ligature from the inflating tube. Should any hæmorrhage again occur, the

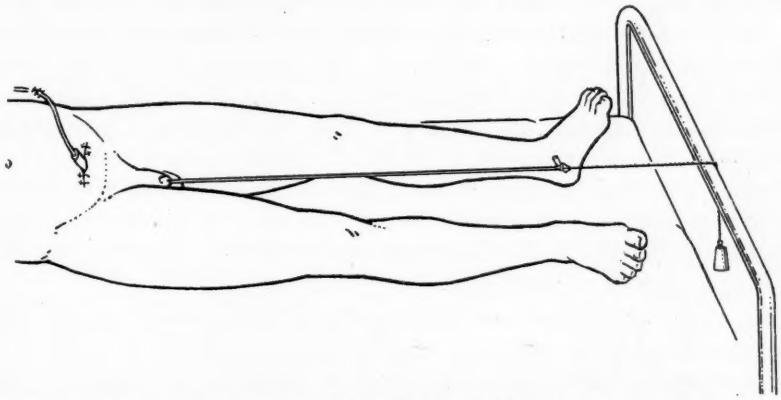

FIG. 51.—Illustrates the method described for holding the bag in position by means of a weight-extension applied to the urethral tube. The suprapubic drain and the inflating tube are seen emerging from the suprapubic wound.

whole apparatus can at once be brought into use by inflating the bag and again attaching the weight-extension to the urethral tube.

This method of retaining the bag in position seems to us more simple and effective than any of the other methods we have seen described. In practice we have found it very efficient and convenient, and infinitely more comfortable for the patient than some of the other recognized methods which we have tried, brief mention of some of which may be of interest.

Methods Previously Employed for Retaining the Bag.—Hagner suggested tying a piece of gauze firmly round the tube just beyond the penis, so that the gauze, coming against the end of the penis, prevented the tube from slipping back along the urethra, and, therefore, the bag from passing up out of the prostate cavity into the bladder. He stated that even this was not necessary, as the cut-off muscle tends to shut down on the tube and hold

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* N.B.—In using this method two points require close attention: (1) Tension on the tube must not be too great; (2) The bag, *when inserted*, must be air-tight. If either point is overlooked, temporary incontinence of urine may occur as a result of over-dilatation of the sphincter urethræ muscle.

the bag in position. We can hardly believe that the muscle would grip the tube sufficiently strongly to keep the bag firmly pulled down into the prostate pouch.

Pilcher fixed the tube to the inner aspect of the patient's thigh by means of strips of adhesive plaster. This method was tried in one of the cases under our observation, but it does not seem so simple and reliable or so comfortable for the patient as the method we advocate.

Various forms of wire cages have been recommended. These fit over the pubic arch or round the upper part of the thighs, and have a projecting portion passing down between the thighs, to which the urethral tube is tied. We have had experience of one such type of cage, and the patient found it extremely irksome.

Method of Removing the Bag.—As a general rule the bag may be removed forty-eight hours after operation, and this is accomplished in the following way: As the bag is removed by the suprapubic wound, it follows that the urethral tube has to be drawn back along the urethra and then up through the bladder. A considerable portion of the tube has been lying outside the urethra, and is therefore probably septic, and some precaution must be taken to prevent the introduction of any sepsis into the bladder. Two methods are suggested :—

1. Before removal is carried out, the external meatus is cleansed, the urethral tube pulled on, and divided with scissors just beyond the penis, thus removing the part of the tube which has been exposed. This means, of course, that the bag is sacrificed and cannot be used again.

2. The external meatus and the extra-urethral portion of the tube may be carefully washed with soap and water, antisepticized with spirit, and lubricated with catheter lubricant. In this way the danger of introducing sepsis may be reduced to a minimum.

The actual removal is simple. The bag is emptied by releasing the clamp on the inflating tube—if this has not already been done—or actually exhausted, if necessary, by suction with a syringe attached to the inflating tube. The suprapubic drain is then removed, and the bag drawn out after it by traction on the inflating tube. Finally, a de Pezzer catheter is inserted to act as a suprapubic drain. In this way removal of the bag can be carried out with very little discomfort to the patient.

Advantages of the Bag Hæmostat.—The advantages claimed for the bag hæmostat here advocated may be summarized as follows :—

1. It is simple, effective, and safe.

2. It is easily and rapidly introduced and easily retained by the method here suggested.

3. It is comfortable for the patient.

4. It is easily removed without pain or disturbance of the healing surface.

5. It tends to mould the prostate cavity and to press down over its walls any ring or strip of mucous membrane left at the vesicoprostatic entrance, thus hastening the epithelialization of the cavity.

6. It ensures the maintenance of a good lumen through the prostate cavity and into the anterior urethra, and so tends to prevent contraction and

partial occlusion of the bladder orifice, a troublesome complication which frequently occurs, delaying the recommencement of urination by the patient and sometimes necessitating the passage of a bougie. Looked at from this point of view, the bag helps to shorten the period of convalescence.

7. The simple method we suggest for retaining the bag in position by means of a light weight-extension applied to the urethral tube is, in our opinion, superior to any other method previously employed, and adds considerably to the usefulness of the bag hæmostat as an instrument for controlling hæmorrhage after prostatectomy.

Illustrative Cases.—The following notes are of five recent consecutive cases. All of them were average cases of chronic retention due to prostatic enlargement. Some had had acute retention and been catheterized on several occasions. All had a preliminary suprapubic cystostomy with insertion of a de Pezzer catheter for suprapubic drainage. In all the bag hæmostat was employed, being retained in the first case by means of an iron cage, in the others by the use of a light weight-extension as described.

Case 1.—Mr. O. Prostate removed about 14 days after preliminary suprapubic cystostomy. No post-operative hæmorrhage. Complained considerably of the discomfort of the cage till the bag was removed. Suprapubic drain removed in 10 days. Began to pass urine about 14 days after operation, leakage from the wound ceasing about the 20th day.

Case 2.—Mr. F. A semi-invalid on admission. Suprapubic prostatectomy 8 days after preliminary operation. No hæmorrhage after leaving theatre. Bag removed in 48 hours, suprapubic drain on 12th day. Passed urine the same night, and passed 70 oz. in the following twenty-four hours. Wound quite healed on 16th day. Left hospital on 27th day after operation.

Case 3.—Mr. B. Over 70 years of age. Prostate removed on 8th day after suprapubic drainage was established. No hæmorrhage. Passed urine on 12th day after operation, and wound dry on the 17th day.

Case 4.—Mr. D. In poor health. Had been in bed off and on for several months. Preliminary drainage for about 14 days. Prostatectomy—considerable hæmorrhage on removing the prostate. Hæmorrhage apparently completely controlled on inserting the bag. Urine passing from suprapubic drain perfectly clear the same evening. Drain removed 12th day. Passed urine the same day, and absolutely no urine escaped from the suprapubic wound thereafter.

Case 5.—Mr. McR. Suprapubic drainage followed by prostatectomy in 10 days. Little hæmorrhage, which ceased on inserting the bag. Passed urine on 12th day after operation. Slight leakage from wound for a few days thereafter, but left hospital with wound dry and healed on the 20th day after operation.

Other Methods Employed to Control Hæmorrhage after Prostatectomy: their Disadvantages.—

1. *Irrigating the Cavity with Hot Water.*—This method is now generally considered to be so ineffective that little need be said concerning it. The stream of hot water probably tends to remove the clots forming in the torn vessels rather than to stimulate their formation.

2. *Methods which Aim at Controlling the Bleeding by Ligature or Suture*, e.g., Thomson-Walker's open prostatectomy, and Fenwick's method of clamp and ligature, using a special speculum through which the bleeding points are seen.

The disadvantages of these methods are: (*a*) Any such procedure must add considerably to the time required to complete the operation. (*b*) In Thomson-Walker's method a very full exposure of the bladder floor is required. (*c*) Considerable skill and practice, as well as special instruments, are needed to carry out these procedures satisfactorily. (*d*) They may fail to control the hæmorrhage completely, in which case some form of packing has to be resorted to as well. (*e*) If a considerable fall of blood-pressure has occurred during the operation, bleeding may cease to a large extent; but reactionary hæmorrhage may occur later from vessels which have not been ligatured because they were not seen to bleed.

3. *Packing the Cavity with Gauze,* e.g., ordinary gauze packing; Barringer's method of using a sponge-holding forceps to keep the gauze plug forced into the prostate cavity; Horsley's method, in which gauze is packed round an in-dwelling catheter in a loop of linen thread attached to the catheter at two points several inches apart, and traction made on the catheter.

These methods may be criticized on the following grounds: (*a*) Ordinary packing does not always control the hæmorrhage, in which case repacking becomes necessary. (*b*) The use of gauze is said to give rise at times to an unusual amount of sloughing of the bladder and wound. (*c*) The removal of a gauze packing often causes considerable pain, and an unnecessary disturbance of the healing surface. (*d*) The use of gauze cannot be considered a clean method; the portion which lies in the prostate pouch and the end which is brought up through the suprapubic wound are continually soaked with urine—not a very suitable 'dressing' to keep closely applied to a healing surface for several days. (*e*) Barringer's method need hardly be criticized, as it is designed for use only in those cases where the patient has been found unable to tolerate a catheter in the urethra. (*f*) Horsley's method seems to the writer to be neither easy nor likely to be reliable, in addition to possessing the disadvantages common to the use of gauze in any form for this purpose.

I wish to express my indebtedness to Professor Fraser, of Edinburgh University, for the help and advice he has given me in preparing this paper, and for permission to publish the notes on cases.

HIGH OR THIRD-DEGREE PROLAPSE OF THE RECTUM.

By K. W. MONSARRAT, Liverpool.

The purpose of this paper is to support the following propositions: (1) High or third-degree prolapse of the rectum is a true invagination. (2) The starting-point of this invagination is always about the junction of the pelvic colon and the rectum.

HISTORICAL.

The condition has not received much attention in the text-books.

Swinford Edwards refers to it as follows: "The patient usually complains of a constant desire to go to stool, and of various uncomfortable sensations in the bowel. Defæcation is accomplished with much straining, and discharges of mucus, perhaps tinged with blood, occur from time to time. In cases which have come under my notice the most marked and sometimes the only symptom has been a very copious discharge of mucus and flakes of lymph, resembling to some extent the profuse watery discharge characteristic of villous disease".

In Tillmann's *Special Surgery* the subject of prolapse of the invaginated colon is discussed, but the occurrence of invagination of colon into rectum without protrusion through the anus is not mentioned. With regard to prolapse of the invaginated colon, the author states that the condition is most frequently reported as a sequel to tumours of the sigmoid flexure.

Lockhart-Mummery does not refer in his text-book to any particular symptomatology associated with high rectal invagination.

Bodkin, of New York, defines 'third-degree prolapse' as follows: "The prolapse begins high up in the rectum or sigmoid flexure, and extends down into the ampulla of the rectum, but does not protrude through the anal orifice". He does not, however, describe any particular symptomatology.

Gant, of New York, devoted considerable space to the treatment of third-degree prolapse by operative measures, favouring excision of the mass below and fixation of the colon above.

It is in Harrison Cripps' book, however, that the clinical description is most complete. He says: "The upper part of the rectum is invaginated into the lower, but not to a sufficient extent to reach the anus. It can be understood how there is little difficulty in the diagnosis of prolapse when the bowel can be actually seen protruding from the anus; but in the third form of prolapse to which I have alluded, and in which there is no protrusion, the diagnosis is not so easy, and I would wish, moreover, to call special professional attention to this variety, for I am confident that it will occasionally afford an explanation of rectal symptoms otherwise unaccountable". In spite of what Harrison Cripps wrote, the clinical course of these cases is not as generally known as is desirable.

TYPICAL CASES.

High or third-degree invagination may occur as an acute condition, and need an emergency operation for its relief.

On June 3, 1920, I was asked to see a gentleman, age 46. He was somewhat stout and florid. Earlier in the day, not having had a normal action of the bowels, an attempt resulted only in the passage of a little mucus, after a good deal of straining and a sensation of something being in the rectum. About two hours later, again having the desire, he passed more mucus, this time blood-stained. Soon after this action he had severe abdominal pain, and this continued intermittently until I saw him about six hours after the first symptoms. He was then in severe pain in the lower abdomen, which was moderately distended; he had passed a considerable amount of blood per anum, but no flatus or motion. The distention and the character of the pain pointed to some form of low intestinal obstruction. Rectal examination revealed within reach of the finger a protrusion into the ampulla with an orifice at its apex; there was blood in the rectum, but no sign of growth. I had never heard of acute colorectal invagination; but the condition found had to be dealt with. He was removed to a nursing home, and I opened the abdomen shortly afterwards in the middle line above the pubis. An invagination involving the lower pelvic colon and the upper rectum was displayed and disinvaginated without any difficulty, and the colon was fixed by sutures to the parietal peritoneum in the left iliac fossa. The patient gave no more trouble, and had no further symptoms of the condition. He died from syncope this year, five years after operation, never having had any intestinal complaint of any sort.

The condition was new to me, and I have not met with it in so acute a form since.

The cases in which the symptoms are subacute and intermittent over a long period are well illustrated by the following history. The patient was a man, age 34. He was observant, and I asked him to write an account of his condition, which he did as follows:—

1. *Symptoms.*—Dull pain at base of rectum, like rheumatic pain, coming on suddenly and gradually getting more intense, as if pressure was being applied to a supersensitive spot inside the rectum near base of spine, combined with a faint feeling.

2. *Effect.*—Sometimes causes complete fainting if unable to lie down flat in time first. Also, sickness on the following day with intermittent vomiting over a period of up to twelve hours. In between periods of attacks severe colic pains with fainting have been experienced.

3. *Period of Attacks.*—Varies in frequency—say, from once or twice a month to once in six months.

4. *Times when Experienced.*—Pain comes on during the day when otherwise feeling fit, and at other times when in bed during the night.

5. *Forms of Relief.*—To lie down flat if possible and if not already doing so. Warmth such as a hot-water bottle applied to base of spine, also sometimes to abdomen or feet. Pain generally going off, or at least decreasing, on passing of wind, which is often impossible at the time until warmth is applied.

6. *Time when First Experienced.*—As far as I can remember, somewhere between the ages of 10 and 15, which would be getting on for twenty years now, the pain then coming on with constipation, as attention was drawn to it by my being found fainting in the lavatory.

7. *Time since at which Chiefly Affected.*—In 1914 and 1915, at the time I had an attack of appendicitis. My appendix was removed in September, 1915, after which I was free of the above attacks for some time, but they commenced again with slight attacks from about 1917 onwards till about 1920, and severe attacks sometimes combined with fainting between 1921 and 1924.

There have to be added to the above notes written by the patient, that he had noticed *mucus in the stools* fairly frequently and in association with the attacks, and that *abdominal colic* usually occurred with the rectal pain.

On rectal examination there was found to be definite telescoping of the bowel above into the rectal ampulla, and the protrusion was œdematous and hypertrophied. Hæmorrhoids were present, and the anus was very sensitive to examination.

On March 10 I fixed the pelvic colon. He has not been entirely free from symptoms since then. On April 1 and 8 he had flatulent pain in the abdomen, and a feeling of distention associated with a feeling of pressure in the rectum ; the attack in each case went off at once on the passage of wind.

I have met with a number of cases similar to the above, and I think the condition is more common than is generally supposed ; when one becomes alive to the significance of a group of symptoms and on the look-out for them, the condition of course turns up more frequently in one's practice.

The end of a colorectal invagination is likely to be eventual protrusion at the anus, and it must not be considered characteristic that the invagination always remains intrarectal.

As in the following case, the passage of mucus and blood is often the most prominent symptom :—

A female patient, age 31, a school teacher, was admitted to hospital on April 23, 1923. She had habitually been constipated until six months previously ; about this time she began to have pain in the act of defæcation, and she also had pain in the perineum apart from the act of evacuation. The motions then became more frequent and more fluid than usual. Two months before admission she had first noticed 'blood and slime' in the motions, and this had continued. Her pain had been of an intermittent type, and had also been felt in the abdomen to the right side of the middle line above the pubis. Speculum examination showed the condition to be one of colon invagination into the rectum, with ulceration of the protruded bowel. In the ampulla was a large quantity of mucopurulent fluid.

What the primary condition leading to this rectal invagination may be is uncertain. An unusually lax mesocolon has been alleged. In some of my cases I have thought that anal spasm was connected with its onset ; however that may be, it is a condition to be borne in mind when a patient comes complaining of pelvic and perineal pain, spasmodic in character and of a peculiar paralysing and distressing type, associated with the passage of mucus and perhaps blood. There are other rectal conditions which will produce very much the same symptoms, more particularly villous growths and polypi, but colorectal invagination must be sought for and excluded.

The following history is of interest with regard to the relationship between high prolapse and anal spasm :—

A gentleman, age 58, had had hæmorrhoids for years with occasional

bleeding. Of late he had had some abdominal pain. The first attack was two years previously, when he had an illness which was considered ptomaine poisoning, the chief symptoms being abdominal pain and the passage of blood and mucus by the bowel. The last attack began twelve days before he was seen, with diarrhœa and abdominal pain; the diarrhœa consisted of mucus and blood. He had since had, off and on, pain in the rectum itself, and a feeling as if the bowel was coming down. On the day when first seen I could make only an abdominal examination; he could not tolerate a rectal examination, and his own medical adviser had also been unable to persuade him to permit this. The anus was held in firm spasm, and all that could be ascertained was that there were external piles of long standing. Under anæsthesia an examination was made with the sigmoidoscope. The pelvic colon was crowded down into the rectum and highly congested; it bled when touched by the instrument. Growth in the colon and rectum was excluded. A barium meal was followed through, and there was no arrest or delay in the large bowel or rectum. This, then, is a case of colon invagination, and it is associated with anal spasm in a very marked degree. For the time being his doctor and I have agreed to have a periodic examination of the fæces and to watch the progress of his symptoms. At the time of the sigmoidoscopic examination he was free from complaints.

DIAGNOSIS.

I believe that if these cases are looked for the condition will be found to be not uncommon. I am aware that, before I appreciated the symptomatology and its interpretation, one met with cases of rectal hæmorrhage and mucus associated with pain in which, when growth had been excluded and ulceration not found, one was at a loss for a diagnosis. I suspect that some of these cases were instances of colorectal invagination.

Regarding differential diagnosis from rectal and colon carcinoma, the condition so closely simulates the common features of cancer that inspection through a sigmoidoscope is essential to its diagnosis. Its clinical course, as compared with that of carcinoma, is distinguished by its intermittency. Instead of the daily small stools of cancerous ulceration, with mucus and blood, there are intervals of complete freedom from any discomfort which may extend to months.

The condition for which it is most likely to be mistaken clinically is 'mucous colitis'; but no surgeon to-day would make a diagnosis of mucous colitis without a sigmoidoscopic inspection. This will at any rate exclude high prolapse, even though the changes in the pelvic colon in mucous colitis are so often inconspicuous.

TREATMENT.

The treatment of colorectal invagination is by *colopexy*. I have the following remarks to make about this operation:—

1. Disinvagination may be difficult. In one of my cases I was not satisfied when the operation was finished that disinvagination was complete. At the bottom of a deep male pelvis, with the wall of the gut œdematous and

somewhat rigid, I felt that recurrence was a possibility. I had to operate on this case a second time, and found the solution of the difficulty: complete disinvagination was impossible without the aid of an assistant's hand introduced entirely into the rectum. Probably this is a very unusual difficulty

2. Fixation to the anterior abdominal wall should not be done. The site for fixation is in the left iliac fossa as low as possible. Fixation should be made after incision of peritoneum and iliacus fascia over an area not less than 6 in. in its long axis. Muscular bands of the colon are sewn to the edges of this incision, and about twelve stitches are required. I prefer silk.

3. The operation cures high rectal prolapse if all the slack of the bowel is taken up, and if sufficient care is taken over the actual fixation.

Fixation of this kind is a perfectly satisfactory method of arresting the prolapse; but colopexy has been somewhat out of favour with surgeons because a few stitches have been relied upon to attach the bowel to the parietal peritoneum.

Considering how careful one has to be in making a permanent colostomy to take in all the proximal slack of the colon if a prolapse is to be avoided, it is surprising that prolapse of colon into rectum is not a more common accident. It is prevented by the anchoring of the bowel at the sacral promontory and below. In prolapse these moorings give and become slack. As far as my observations have gone, it would seem that that portion of gut where pelvic colon becomes rectum forms the apex of the invagination, and that as this advances into the rectal ampulla the latter is progressively turned outside in. In other words, the type of invagination appears to be the analogue of ileocæcal intussusception. I have not met with any case of colorectal invagination analogous to the ileocolic intussusception of the other end of the large bowel.

SUMMARY.

I would sum up the clinical facts regarding colorectal invagination (the so-called high or third-degree prolapse) as follows:—

1. It seems to be connected in some cases with a condition of anal spasm.

2. It may occur as an acute condition causing symptoms of obstruction.

3. Anatomically it is a turning-in of the rectum into itself, commencing at its upper end.

4. As a chronic condition its main symptoms are discomfort and difficulty in defæcation, a peculiar rectal pain described by patients as paralysing, and the evacuation of mucus and usually blood.

THE SURGERY OF THE LUNG.

By JOHN T. MORRISON, Liverpool.

The surgery of the lung has attracted attention from a much earlier date than would at first sight seem probable. It is stated that the lung was resected in man as far back as 1884,[1] but I have been unable to trace the exact reference. Since then a large amount of experimental work has been done, to shed light upon the problems peculiar to operative work in this field. In the early days sepsis led to the speedy death of almost every animal that survived the shock of the operation, and proved a terror even in the hands of so great a surgeon as J. B. Murphy.[2] In 1909 Sauerbruch[3] reported the survival of only 4 animals out of 38 operated on.

In the minds of almost all, surgeons and experimenters alike, the risks of an open pneumothorax loomed large. Accumulated experience of war wounds, however, has taught us that expensive and complicated methods are not necessary to cope with this danger, and that, while a 'sucking' wound is of grave omen, a widely opened thorax permits of extensive operative procedures on the lung in comparative safety. Since those days a controversy has raged as to the exact conditions under which respiration is carried on in such cases, and as the question is one fundamental to our subject it must be briefly alluded to.

One school insists on the pliability of the mediastinal curtain, and shows that alterations of pressure on one side are automatically and tolerably accurately reproduced upon the other. The corollary of such a position is of course that, given the cross-sectional area of the trachea, and the vital capacity of the individual, it is merely a mathematical problem to determine how large an opening may be made, in either one or both sides of the thorax, before the lungs cease to function, and death from asphyxia results. The area of such openings has been variously computed at from 64 to 102 square centimetres. Of this line of argument Graham, of Washington, is one of the leading exponents.[4]

Graham, however, has to face the undoubted fact that large thoracotomies have frequently been made, far exceeding the highest estimate of the area of safety. Pierre Duval, whose reputation as an operator on the chest was firmly established during the war, declares indeed that safety lies in securing a very wide opening into the chest, and as complete collapse as possible of the lung upon that side.[5]

It is possible that the truth lies somewhere between the two positions. The mediastinal curtain is no doubt a structure most sensitive to variations in pressure; but even in health it surely has a limit to its pliability. On the other hand, may it not be that Duval does not fully realize to what an extent he diminishes the opening into the chest when he puts his hand in, or when he

draws the lung out, and that every manipulation of the lung tends to fix the mediastinum, and so interfere with the transmission of positive pressures to the unopened pleura ?

EXPERIMENTAL METHODS.

For the last two and a half years I have been investigating some of the problems involved in the removal of lung tissue, and the technique necessary in such operations. I was interested, too, in the measures adopted by nature to readjust the relations of the intrathoracic organs. This experimental work has been done entirely on rabbits. The anæsthetic used was simply open ether given on a towel.

I began by making a vertical incision through the costal cartilages from the 4th to the 9th, but soon gave this up in favour of an intercostal incision in the 4th space, extending from close to the sternum to nearly the posterior axillary line. The wound is widely opened by a mechanically actuated self-retaining retractor. A few moments' delay after opening the pleura allows the respirations to quieten down. The lung can then be seen partially collapsed, and easy access is had to the root. It was soon found that with the chest thus widely opened, once the anæsthetist had gained a little experience with the animals, no difficulty arose that could be traced to the open pneumothorax. Small portions of lung were removed, and later whole lobes, without difficulty and without ill-effect. At first I was careful to suture pleura, invaginating the wound as war experience seemed to indicate was essential ; but owing to the awkwardness of delicate manipulations in the confined space of a rabbit's pleura I abandoned this step. Results were in no way different. There was no single case of sepsis from first to last, and I attribute the importance of suturing the pleura in war wounds to the invariably infected nature of the trauma. In these rabbits, on the contrary, even the primary divisions of the bronchi were always found to be sterile. The method finally adopted was simply to crush the base of the piece of lung to be removed with a clamp, and ligature with No. 1 ten-day catgut. The chest was closed, of course without drainage, with interrupted through-and-through stitches of chromic gut encircling adjoining ribs.

When now I came to resect a whole lung, I found myself invariably unsuccessful. In every case the animal died either at the moment of clamping the pulmonary root or else almost immediately after. The respirations at once became very deep and irregular and speedily ceased, usually in full inspiration, the chest gradually subsiding as the animal died. The heart continued to beat for some time. In one case only could I find any local condition that could have had any bearing on the fatality—namely, in one rabbit in which a certain amount of blood had been aspirated into the main bronchus of the opposite side.

It then occurred to me that the cause of the trouble was a nervous interference with the reflex of respiration by powerful stimuli passing from the grossly traumatized pulmonary root, via the anterior and posterior pulmonary plexuses. I therefore divided the vagus in the neck, on the first occasion three weeks beforehand, but later on as a first stage in the main operation. The result was astounding, for one could then remove with ease the whole lung,

without any change in respiration or heart-rate sufficient to cause the least anxiety. In one case a vagus block with novocain appeared to give as complete security as division of the nerve, but preliminary administration of atropine failed to influence the mortality. Since this simple prophylactic has been adopted, I have had no deaths from complete resection of one lung, except in one case where the ligature on the root slipped, and bleeding quite uncontrollable in the tiny space of a rabbit's pleura followed. The animal died the following night.

FIG. 52.—Transverse section of adult rabbit: normal control. R, Right lung; L, Left lung; H, Heart; P, Posterior mediastinum.

RESULTS OF EXPERIMENTAL OPERATIONS.

The results of these operations may be looked at in two ways: first of all as regards the effect on function; and, secondly, as regards anatomical and histological changes in the remaining viscera. The well-being of the animals did not appear to be in any way affected, and indeed they seemed particularly well nourished and quite vigorous. Attempts on the part of the laboratory attendant to catch them, when they were let loose, resulted in considerably more dyspnœa on the part of the huntsman than on the part of his quarry.

The anatomical and histological changes found are most instructive. The animals were killed at intervals varying from three to six months after operation, and the specimens prepared as follows: Immediately after being chloroformed, the femoral artery was opened, and 10 per cent formalin injected until the twitching of the muscles all over the body showed that the animal had been thoroughly infiltrated. It was left lying in a weak solution of formalin till thoroughly hardened, and sections were then carefully cut.

During life there is strikingly little asymmetry of the chest to be seen, but when sections are studied it will be noticed that the operated side is considerably smaller than the other. This appears to be brought about in various ways. In the earlier cases where the cartilages had been divided, the posterior cut ends slid forwards over the anterior ends. In those where an intercostal incision was employed there was crowding together of the ribs, and no doubt

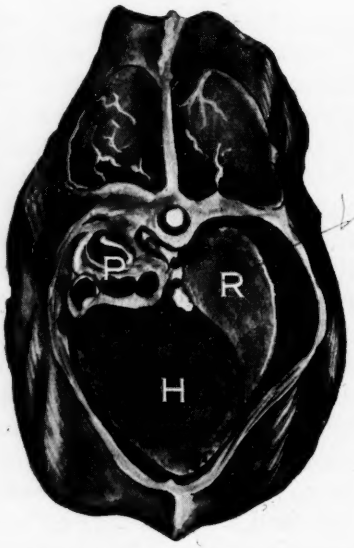

FIG. 53.—Transverse section of adult rabbit six months after left total pneumectomy. The drawing shows a reverse view. Note how the right half of the thorax is occupied by the heart (H) and great vessels (P). R, Right lung.

some accompanying scoliosis. In addition to this, the size and relationship of the remaining intrathoracic structures are altered, so as to fill to some extent the place of the lost lung.

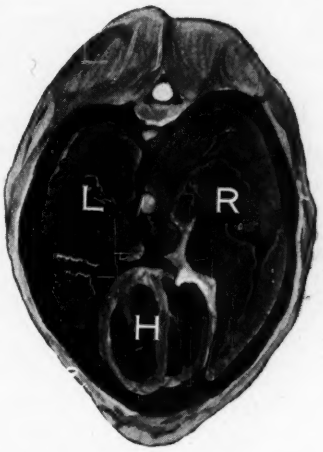

FIG. 54.—Transverse section of adult rabbit: normal control. The drawing shows a reverse view. R, Right lung; L, Left lung; H, Heart.

Of these, the part played by the heart is a difficult and important one. The impression gained from a study of the cross-sections (*Figs.* 52 and 53) would suggest that there is enlargement of the organ; but observation of a number of controls prepared as nearly as possible in the same way shows considerable variations, or apparent variations, in normal animals both in the size of the heart and in the thickness of its walls. Although I personally consider that the wall of the right ventricle is never so thick as after pneumectomy, the degree of difference in some of the controls is not such as to make the fact self-obvious. After all, the available channels of escape for the blood from the right ventricle are immediately diminished by anything up to 50 per cent, and hypertrophy, one would think, must follow, or dilatation and heart failure inevitably result. As a matter of fact, the researches of Heuer and his associates have shown that the output of the heart after total pneumectomy is increased.

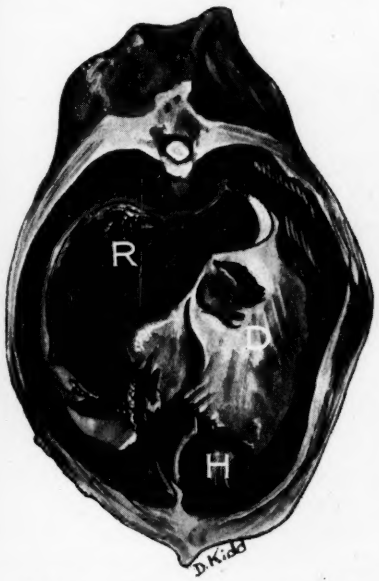

FIG. 55.—Transverse section of adult rabbit six months after left total pneumectomy. This section has unfortunately been cut slightly lower than *Fig.* 54, so that only the apex of the heart is seen. The characteristic bulging of the base of the right lung into the left thorax is well seen. R, Right lung; H, Heart; D, Diaphragm covered with fat.

A study of the cross-sections of the whole thorax shows that the heart lies close to the ribs on the left side of the chest; but if its relationship to the middle plane is compared in the two transverse sections, it is clear that there is surprisingly little displacement of the organ.

In regard to the lung, several interesting points arise. It is very striking how the posterior mediastinum is pushed over to the operated side by the lower lobe of the remaining lung (*Figs.* 54 and 55). In a specimen of long-continued collapse of the left lung in man in the pathological museum of the University of Liverpool, it is most instructive to see how a somewhat similar change has taken place. The upper lobe of the right lung has pushed the mediastinum—the superior mediastinum—before it as it has passed in front of the great vessels and the upper part of the heart over to the collapsed side.

It is claimed by Kawamura[7] and Da Fano[8] that there is an actual hypertrophy of the remaining lung; but, to say the least, this appears doubtful. Two types of change are seen to take place, but both would seem to be of a pathological rather than of a physiological order.* In some a development takes place analogous to so-called compensatory emphysema (*Figs.* 56 and 58), although the capillary vessels in the alveolar walls are for the most part well preserved. The patchy character of this change is curious (*Fig.* 58).

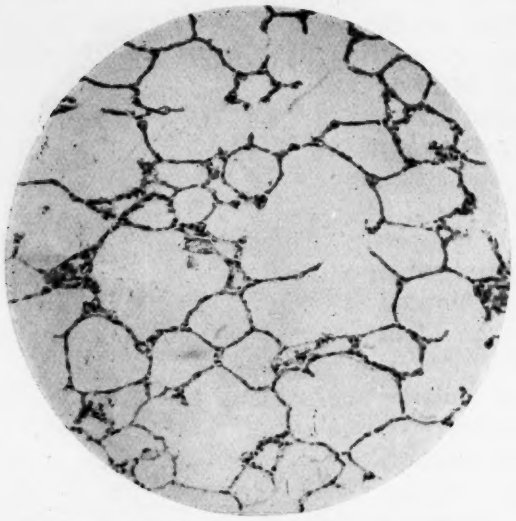

FIG. 56.—Well-marked emphysema of remaining lung after total pneumectomy.

In other sections of the lung, and these the more numerous, an intense vascular engorgement is found (*Fig.* 57). Careful study of this type shows the air spaces on the whole increased in size but diminished in number in any one field. The epithelium lining them is greatly stretched, the nuclei being few in number and far apart. The arrangement of the blood-vessels does not suggest new formation of capillaries, but rather a great distention and thinning of those which already exist—so much so, indeed, that in many instances the vessel walls are very hard to distinguish, and the microscopic appearance is that of sinusoidal tissue. The presence of many granules of blood pigment would bear out the above interpretation, granted the very natural assumption that this intense engorgement leads to many small hæmorrhages. It was pointed out to me by Professor Ernest Glynn—to whom I am indebted for much helpful comment—that it would probably be found that the emphysema occurred in the less well-supported parts of

FIG. 57.—Remaining lung after total pneumectomy, showing intense engorgement and thickening of the alveolar walls.

* It is perhaps only fair to Da Fano to state that the animals used by him were only ten weeks old, and it is possible that true hypertrophic changes might occur at this age, whereas in the adult animals used in my experiments such recuperative efforts on the part of nature might well fail.

the lung, the congestive changes in other areas. This suggestion I have been able to confirm. It is stated by Da Fano that acute vesicular emphysema supervenes throughout the whole lung within three days of the operation. If it be so, it is noticeable that the animals show no striking respiratory distress during this period.

Lastly, the specimens suggest that there is an increase of fat, both in the superior and posterior mediastinum. This third method of obliterating dead space is most convincingly demonstrated in *Fig. 55.*

The empty pleural cavity is, of course, to begin with, filled with air; but in the course of two to three weeks, as has been shown by Heuer following up these cases radiographically, the air is mostly absorbed. In my specimens the anterior or ventral portion becomes largely obliterated by fine adhesions, while the dorsal part tends to remain free. This may be because any blood that is left in the pleura will naturally accumulate ventrally, where it will, in time, induce a plastic pleuritis. In no animal was any fluid found post mortem. In one case of partial resection of a lobe, three weeks after operation a long thread-like adhesion running from lung to diaphragm was found. The lung itself was so soundly healed that even microscopically it was extremely doubtful where the resection had been done. In complete pneumectomies the stump of the root of the lung becomes embedded in fibrous tissue and covered with smooth pleura. In no case was there any leakage from a bronchus.

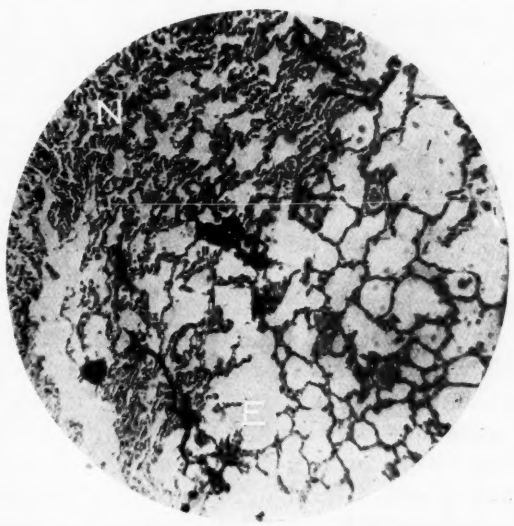

FIG. 58.—Section showing patchy distribution of emphysema in remaining lung after total pneumectomy; adjoining lobules show respectively a practically normal appearance (N) and well-marked emphysema (E).

This work confirms in its leading features the results of Da Fano, and of Heuer and Dunn of the Johns Hopkins Hospital. The latter carried out their work on dogs, using intratracheal pressure anæsthesia; the former operated upon rabbits, the method of anæsthesia not being stated. Neither seems to have had trouble with shock as I did in performing total pneumectomy on rabbits, and, so far as one can judge, the essential difference in technique lay in the disposal of the hilum. In the larger animals Heuer was able to isolate and tie separately the pulmonary artery and veins. The bronchus was sometimes subjected to crushing. Da Fano simply applied a mass ligature of silk to the whole root of the lung, but without preliminary clamping. It may be that these methods inflict less violent, or perhaps less sudden, trauma on the nerve plexuses in this region, and that this accounts for the success of these workers.

Nevertheless, out of my failure a striking fact has come, namely, that

by vagus blockage I could prevent a death which otherwise ensued with certainty, and it may be that this observation will find a useful application in the human subject. Lilienthal tells us that, even in excision of a single lobe in man, shock is a factor to be seriously reckoned with. Partly, no doubt, this is due to trauma inflicted on the chest wall; but this he has already tried to eliminate by infiltration and intercostal blockage with local anæsthetics. There remains the factor of shock due to intrathoracic trauma, and it is clear from his experience that anything which will diminish this risk will go far to improve the results of operation. Here the greatest possible delicacy in handling the hilum, and vagus blockage, would appear to go hand in hand. In a private communication from Morriston Davies, he tells me that he has already made use of this procedure in a case of partial pneumectomy in man with a very satisfactory result.

Finally, I would draw attention to the extreme simplicity of the administration of the anæsthetic, and to the fact that the thorax remained widely open for many minutes without serious ill-effect on heart or respiration. The size of the opening was diminished only by the insertion of instruments, except at the moment of tying the ligature.

APPLICATION OF THE EXPERIMENTS TO MAN.

The gulf between these operations and the application of the experimental results to man is, I fear, both wide and deep. To a certain extent, it is true, the margin of safety is often increased in man by adhesions of lung to chest wall, or increased rigidity of the mediastinum; but on the whole the scales are weighted heavily against the surgeon by the fact that in disease the human bronchi are so frequently, if not invariably, infected. To cope with this, many expedients have been devised, such as the application of grafts of lung tissue to the cut bronchus, drainage directly to the surface through a rubber sleeve, and even the eventration (if we may use such a term of a thoracic structure) of the infected stump. Infection still remains, however, one of the gravest risks in pulmonary surgery.

The most extensive record of the surgery of the lung in civil practice that I have been able to find is that of Lilienthal.[9] In the operative treatment of bronchiectasis a heavy mortality—well over 50 per cent—proves the need for further advances in technique before surgical methods can make any real contribution to the treatment of this condition. The chief causes of death were first shock, second sepsis. The whole lung has been resected for unilateral tuberculosis by Stretton, Tuffier, Doyen, Lowson, Sonnenburg, and Macewen—by the latter on four occasions. In 1906[10] he described the case of a man whose left lung was riddled with tubercle. It was completely removed, and I am informed by Mr. John Macewen that this man is still alive and is doing light work. Heidenhain[11] reports the removal of the lower lobe of the lung for bronchial fistula, and local resection of lung for a tumour of the chest wall adherent to visceral pleura. Kummell[12] removed the whole of one lung for a primary carcinoma, but lost the patient six days later from an acute bronchitis affecting the remaining lung.

In all the instances above quoted one cannot but be struck by the great

gravity of the conditions dealt with and by the grievous mortality. But is it not so with all new procedures? It is only as diagnosis is made earlier and with greater accuracy, while at the same time the knowledge of pathology grows and technique improves, that the mortality falls. Nothing could be further from the writer's mind than the idea that surgery is immediately to supply the appropriate treatment for local diseases of the lung. On the other hand, enough has been done to indicate that in this sphere, too, closer co-operation between physician and surgeon will lead to the greater benefit of the patient. It has been said by Lilienthal[13] that we have at our disposal in exploratory thoracotomy a simpler and more effective method of diagnosis than in exploratory laparotomy, while at the same time, if no further operative procedures are undertaken, the resulting invalidism is much less. Such operations, too, will open up a way to the knowledge of that 'pathology of the living' which has done so much to advance the treatment of diseases of the alimentary system. May it not equally be the prelude to discoveries that will bring relief to those who suffer from hitherto incurable diseases of the lung?

Acknowledgements are due to Professor J. M. Beattie, in whose laboratories the work was done, for every facility offered; and to Mr. Douglas Kidd, of the University Department of Pathology, for the illustrations.

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TREATMENT OF CEREBRAL TUMOURS.*

By PERCY SARGENT, London.

In the following brief survey of a personal experience of cerebral tumours, I shall deal exclusively with the operative treatment of true neoplasms, taking no account of those cases of tuberculoma, syphiloma, and other conditions which may give rise to similar or identical symptoms. As to treatment other than operative I have no remarks to make, seeing that any such can only be palliative even in intention. At the present time all forms of radiotherapy have been disappointing in their results, although in a few instances the employment of radium combined with operation, i.e., the burying of radium in a glioma, has seemed to modify the natural course of the case appreciably.

Classification of Cerebral Tumours.—Intracranial tumours may be classified regionally or histologically, but from the surgical standpoint a grouping which combines the two is convenient. For the purposes of this communication I shall consider only the following groups: (1) *Cerebral gliomata*; (2) *Cerebellar tumours*; (3) *Endotheliomata*; (4) *Cerebellopontine tumours*; (5) *Pituitary tumours.*

The grouping of the gliomata according to their clinical behaviour and histological characters is beginning to be possible, and is of great importance from the point of view both of treatment and prognosis. There are, for example, those which undergo spontaneous cystic degeneration, where little can be found even microscopically of formed tumour structure, and where there is little or no infiltration of the surrounding brain. These are most often found in the cerebellum, and they may pursue a clinically benign course. Others are firm, solid, almost circumscribed tumours, having the appearance, at least to the naked eye, of being encapsuled: they are sometimes capable of removal with apparent completeness. The commonest variety, however, is the infiltrating, rapidly growing kind. In the future some definite histological differences may allow of a more scientific classification; but so far as my experience goes at present these three varieties resolve themselves into clinical groups, clearly demarcated in their history, course, and therapeutic requirements.

When planning an operation for an intracranial tumour, it is necessary to know as nearly as possible: (1) Its exact situation; (2) Its nature; and (3) The degree of intracranial pressure to which it may already have given rise. Unhappily even to-day, in the majority of cases so much time has already been lost before surgical aid is sought that it is the general

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intracranial pressure which governs the situation, and this regrettable state of affairs must persist so long as students are taught to repeat, parrot-wise, that the symptoms of cerebral tumour are "headache, vomiting, and optic neuritis". This trinity of symptoms is in reality indicative of impending death, and in the majority of cases marks the fact that the time for radical treatment, even if that had ever been possible, has passed by.

Diagnosis.—The diagnosis of cerebral tumour can in a very large proportion of cases be made, and ought to be made, before the onset of severe pressure symptoms, and this, speaking generally, will be commonly done only when the general physician has familiarized himself with the appearance of an optic disc which exhibits the earliest stages of papillœdema. The electric ophthalmoscope affords a means by which any practitioner is able to inspect the optic discs. In many instances, again, cerebral tumour can be diagnosed even when the discs are perfectly normal—for example, tumours of the cerebellopontine angle and endotheliomata affecting the motor, sensory, or visual cortex. The existence of any considerable degree of intracranial pressure obscures localization, forbids immediate radical treatment, and seriously prejudices the patient's prospects.

Apart from the vital question of intracranial pressure, there are two fundamental points which ought to be decided, in so far as it is possible to do so, before any operation is undertaken—namely, the exact situation and nature of the tumour.

Localization.—This must, I think, remain the special province of neurologists, at least until physicians in general realize that anyone may become capable of localizing a tumour who, with a working knowledge of the anatomy and physiology of the brain, will take the trouble to investigate the details of the history of the case, and make a systematic examination for all the well-known signs of impairment of function. It is not from want of knowledge but from failure to apply knowledge that most mistakes are made. It is astonishing to hear, as I have heard, the statement that mechanical means of diagnosis, like ventriculography, are required because only about 30 per cent of cerebral tumours can be localized by neurological signs. Happily this is very far from the truth, and from my own experience with my colleagues at the National Hospital for the Paralysed and Epileptic I can say confidently that the percentage is nearer 90 than 30. This being so I have naturally had little experience of ventriculography; but that experience, such as it is, together with such information as I have been able to derive from a study of the literature, does not encourage the hope that much is to be expected of ventriculography as a means of localization.

Nature of the Tumour.—In this respect we are not yet on such firm ground as with localization, but the nature of the tumour can often be predicted correctly. The grounds upon which an opinion can be based are:—

1. Its situation. Cerebral tumours are rarely any but gliomata or endotheliomata. In the frontal and post-central regions gliomata are twice as common as endotheliomata; in the occipital lobe six times as common; and in the temporal lobe thirteen times as common. Cerebellopontine tumours are mostly neurofibromata; pituitary tumours are most commonly adenomata; and cerebellar tumours are almost invariably gliomata. Leaving out

of consideration the cerebellopontine and pituitary tumours, the gliomata constitute 69 per cent and the endotheliomata only 20 per cent of the total number.

2. The history. Naturally a history extending over several years suggests a benign tumour ; but a brief history does not, on the other hand, mean that the tumour is not benign, for a very slow-growing tumour may for years produce no symptoms at all, or the initial symptoms may have escaped the notice of the patient and the observation of his physician. It is not, however, only the length of time that symptoms may have existed which is important, but the rapidity of their progress. It is, I am convinced from experience, possible for a glioma to have existed for years, and then to take on active growth, so that signs of impairment of function manifest themselves in rapid, steady, and orderly sequence. It is not easy to distinguish between the symptoms due to encroachment of the actual tumour and similar symptoms caused by hæmorrhage into or œdema around the tumour. The latter, however, are always more rapid in onset, more variable in their character, and not so steadily progressive in their course.

Lesions other than true neoplasms cause symptoms indistinguishable from those of tumour, but with these I am not now concerned, except to point out that :—

1. Localized syphilitic and tuberculous masses are, in my experience, very rare.

2. Chronic abscess simulating tumour may be diagnosed from the presence of a possible source of origin in the history or in some existing septic focus, together with the condition of the cerebrospinal fluid. In my experience an abscess rarely or never exists in the presence of a perfectly normal cerebrospinal fluid ; but, on the other hand, fluid similar to that found in abscess cases is sometimes present in cases of glioma. Hydatid cysts are, in England at least, exceedingly rare. I have encountered only one example amongst some hundreds of cases operated upon for cerebral tumour.

Radiography sometimes gives information, by showing the presence of opacities in a meningeal tumour or the shadow of a tuberculoma, or changes in the bone overlying an endothelioma, whilst of course the existence of a palpable bony thickening of long duration, coupled with symptoms of an intracranial tumour in that situation, makes the diagnosis of endothelioma certain.

To sum up, it may confidently be stated that in the vast majority of cases an intracranial tumour can be accurately localized, and in more than half the cases its nature can be correctly stated.

Scope of Operation.—The ideal operation aims at complete removal of the tumour, without producing any further neurological damage, and by an approach which leaves the patient without a cranial defect. The cases in which this ideal is possible of attainment are unhappily few in number. The conditions cannot be fulfilled in the case of any infratentorial tumour, because a cranial defect necessarily remains, even in the rare cases where the tumour is of such a nature and so placed as to be capable of complete removal without damage to the surrounding nervous structures. They can rarely, if ever, be fulfilled in the case of tumours in the pituitary region, since such tumours, in

my experience, are never capable of complete removal. In the case of the gliomata of the cerebral hemisphere the nature of the tumour and the stage to which it has advanced when the operation is undertaken almost invariably render complete removal impossible, even if that could be achieved without causing further neurological damage, and if the state of the general intracranial pressure were such as to permit of the operation being done through an osteoplastic opening.

It is really therefore, with few exceptions, only the endotheliomata which are accessible, accurately diagnosed beforehand, and approached through an osteoplastic opening, that are capable of the ideal radical treatment which I premised. In my own experience these constitute only 12 per cent out of a total of 336 operations for cerebral tumour. For one reason or another, such as wrong diagnosis, post-operative fatalities, and operation at too late a stage, the actual percentage of such results attained was only 5.

1. CEREBRAL GLIOMATA.

Let us now see what results may be expected in the case of the gliomata of the cerebral hemispheres. In the majority of these cases nothing was done beyond a simple decompression; in a few, cysts were emptied, or partial removal of a solid tumour was effected. In some, radium was buried in the growth for twenty-four hours. A few were submitted to X-ray treatment.

Frontal Gliomata.—42 cases (6 cystic):—

17 died shortly after operation
4 were discharged from hospital and not traced
10 survived for an average period of 8 months
8 were living upwards of 2 years after operation
3 made remarkable recoveries.

Occipital Gliomata.—12 cases (1 cystic):—

3 died shortly after operation
1 was discharged but not traced
6 survived for an average period of 4 months
1 lived for 3 years
1 was alive and well, but hemiparetic, 11 years after operation.

Post-central Gliomata.—31 cases (5 cystic):—

4 died shortly after operation
3 were discharged but not traced
18 survived for an average period of 8 months
6 were alive and well, though with various degrees of disability, after an average interval of 22 months.

Temporal Gliomata.—25 cases (3 cystic):—

3 died shortly after operation
4 were discharged but not traced
12 survived for an average period of 10 months
6 were alive and well, some with disability of various degrees, after an average period of $4\frac{1}{2}$ years.

The results of operations upon the gliomata are summarized in *Table I.*

Table I.—Results of Operations on Cerebral Gliomata.

	Number of Cases	Post-operative Deaths	Not Traced	Good Recoveries	Average Survival of Remainder
					Months
Frontal ..	42	18	4	8	8
Occipital ..	12	3	1	2	4
Post-central ..	32	4	3	6	8
Temporal ..	26	3	5	7	10
Total ..	112	28	13	23	7–8

For the sake of comparison I may mention that during the same period the following malignant tumours other than gliomata were met with—namely, 14 sarcomata and 2 secondary carcinomata. Of the sarcomata, 6 were frontal, 2 occipital, 5 post-central, and 1 was temporal; of the carcinomata, 1 was post-central and 1 frontal. There were also 2 cases of cholesteatoma and 1 of hydatid cyst.

2. CEREBELLAR TUMOURS.

In the present series there have been 57 operations for cerebellar tumour (excluding cerebellopontine tumours, which are considered separately). Of the 38 in which the nature of the tumour was verified, 25 were gliomata, 4 sarcomata, 2 secondary carcinomata, and 7 tuberculomata. In the remaining 19 cases either no tumour was found, or its nature was not ascertained. The post-operative deaths were 11 in number (19·2 per cent). In the 25 verified cases of glioma no fewer than 10 were gliomatous cysts, a remarkably high proportion when compared with the gliomata of the cerebrum (40 per cent as against 13·5 per cent). Seven patients are alive and well at an average period of 3 years after the operation, whilst the average survival period of the remainder was 13 months. Comparing these figures with those of the cases in which a simple decompression was done for unverified tumour, we find that 7 are alive and well at an average period of 2½ years after the operation, whilst the average survival period of the remainder was 8 months.

To sum up briefly what my own experience has led me to expect as the result of operative measures in the case of the cerebral gliomata, I would say that about 25 per cent of the patients die shortly after operation; about 50 per cent die within eight months; and about 25 per cent make good recoveries, some able, for several years at any rate, to live useful lives and to earn their living. When we reflect that these patients are suffering from a tumour which, left alone, will inevitably prove fatal, often after a period of blindness and intense suffering, we may feel that such results, meagre as they may be, are not to be despised. They are at least as satisfactory as those obtained in the treatment of cancer of the œsophagus or rectum. It should be pointed out, too, that in the series quoted there has been no picking and choosing of cases. With very few exceptions of persons actually *in extremis*, every patient has been given such chance of relief as operation seemed to afford, so that many cases are included which, had the exact extent and nature of the

tumour been known beforehand, might not have been submitted to operation. Further, there can be no doubt that some of the bad results in the earlier cases, of twenty years ago and more, were due to errors of judgement and faulty technique.

When we turn to the cerebellar gliomata, we find that although these tumours are so situated that they can more easily cause rapid and severe increase of intracranial tension, as compared with the majority of supratentorial tumours, and in a region where the operative risks and difficulties would naturally be expected to be greater than in the case of supratentorial, yet on the whole the outlook is definitely more favourable. This can be accounted for in several ways. First, the exact localization of a cerebellar tumour is usually easier than that of many of the supratentorial gliomata; secondly, the tumours in this situation are more liable to undergo degenerative changes, as indicated by the very high proportion of cysts, which are three times as common in cerebellar as in cerebral gliomata; and, thirdly, in the remarkable capacity which exists for compensation of cerebellar function. As compared with gliomata of the cerebrum, the operative mortality is less than half, the proportion of good recoveries is higher, and the average survival period of the remainder is nearly twice as long.

3. ENDOTHELIOMATA.

The results of operation on endotheliomata of the cerebral membranes are set out in *Tables II* and *III*.

Table II.—Tumour Completely Removed.

	Number of Cases	Post-operative Deaths	Good Recoveries	Average Survival of Remainder
				Months
Frontal ..	18	5	12	18
Occipital ..	2	0	1	3
Post-central ..	10	2	6	8
Temporal ..	1	0	0	12
Total ..	31	7	19	10

Table III.—Decompression Only.

	Number of Cases	Post-operative Deaths	Good Recoveries	Average Survival of Remainder
				Months
Frontal ..	4	1	0	8
Occipital ..	0	0	0	0
Post-central ..	5	1	3	12
Temporal ..	1	0	0	2
Total ..	10	2	3	7

It will be seen therefore, that of 41 cases of endothelioma, the tumour could be, and was, completely removed in 31, and that of these, 19

made a good recovery and were alive and well at the time of writing (46 per cent).

The operative mortality compares very unfavourably with that which occurred in the case of the gliomata; but I would emphasize the fact that I have included all my earliest cases of some years ago, when the technique of these operations was crude and ill-developed, when localization was less accurate, and when enucleations were carried out in the presence of a greatly raised intracranial pressure.

These tumours, innocent in nature, and susceptible of early and accurate diagnosis, are the most favourable of all the intracranial tumours for radical treatment. Yet, in spite of every favourable circumstance, unlooked for and undeserved fatalities sometimes occur. One of the most promising cases which I ever saw, after an entirely uneventful recovery from the operation, developed, on the third day, an uncontrollable succession of Jacksonian fits, so that the patient died of exhaustion. Others, of apparently far less favourable aspect, have made complete and uneventful recoveries.

4. CEREBELLOPONTINE TUMOURS.

During the period under review I have operated upon 47 cases of tumour situated in the cerebellopontine angle. The nature of 40 of these tumours was ascertained, and was as follows: 36 neurofibromata (4 completely cystic), 2 cholesteatomata, 1 sarcoma, and 1 fibroglioma. In 9 the tumour was completely enucleated, with but a single recovery, the patient being in perfect health four years later.

In 11 cases only a decompressive operation was done, the tumour being untouched, or only a fragment of it being removed for examination. Amongst these there were 4 post-operative deaths, the average survival period of the remainder being five years.

In 27 cases the tumour was removed as completely as possible from within its capsule, the mass being broken up and removed piecemeal by suction. Of these patients, 4 died shortly after the operation, whilst of the 25 survivors, 2 died a year later, 2 were alive and well upwards of four years, 2 three years and upwards, and the rest two years and under.

5. TUMOURS AND CYSTS INVOLVING THE PITUITARY REGION.

I have operated upon 68 cases of supposed pituitary tumour, in all of which the determining factor was the hope of saving or improving vision. In the case of the pituitary adenomata, with conspicuous symptoms of glandular disturbance and characteristic X-ray appearances, the diagnosis is easily made, but in many other cases the exact state of affairs can only be ascertained by exploratory operation. I have therefore divided my cases, for the purposes of the present report, into two classes:—

1. *Pituitary tumours proper*, mostly adenomata, arising in the sella turcica and invading the cranial cavity. Of these there have been 33 cases with 9 deaths (the majority naturally amongst the earlier operations of the series): 4 trans-sphenoidal operations with 1 death, 1 temporal operation with no

death, 28 trans-frontal operations with 8 deaths. In my last 15 cases there have been only 3 deaths.

2. *Suprapituitary tumours*, arising above or in close relation with the sella, including infundibular, interpeduncular, and frontal lobe tumours, and cysts of various kinds. Amongst these there have been 6 temporal operations with one death, and 29 trans-frontal operations with 3 deaths.

Whilst it is a simple matter to indicate statistically the results of this or any other operation as regards immediate mortality, it is not easy to set out in any such straightforward manner the far more important results which concern the condition of those who emerge successfully from such operations. This is not the place to go into the details of individual cases, and one must be content to give one's impressions of the results in their broadest aspects. Judged first from the point of view of visual disturbance, the outstanding symptom for which, at present, pituitary operations are generally performed, the gain has in practice proved to be such as greatly to outweigh the operative risks, and it is quite certain that, when these cases are submitted to operation at an earlier period, before the power of recovery of the visual paths has been seriously impaired, the results as regards vision will be still more gratifying. It is for the ophthalmic surgeon more than anyone else to make himself acquainted with the progress and possibilities of pituitary surgery, for it is chiefly to him that these patients entrust themselves for advice and treatment. Judged from the point of view of comfort, the relief of pressure afforded by these operations results in freedom from headache and often an improved mentality. The patients become brighter, more alert, and better able to carry on with their occupations. It is too early to say anything as to the effects from a standpoint of endocrine function. In a few instances there have been rapid and definite alterations in the metabolic and other disturbances, but how far these may be but transitory is not at present known. They are, however, such as to suggest that, with the increasing safety of the operation, it may come within the scope of legitimate surgery to operate for the arrest of acromegaly in its early stages.

TWO HUNDRED CASES OF CANCER OF THE RECTUM TREATED BY PERINEAL EXCISION.

By J. P. LOCKHART-MUMMERY, London.

HISTORICAL.

The operation for the removal of rectal cancer has undergone very considerable changes during the last twenty-five years, and we may roughly divide these changes into four periods. During the first period surgeons removed the growth by splitting up the rectum and dissecting out the growth, working from inside the rectum, or at least with one finger in the bowel. The operative field was necessarily soiled, and inevitably became septic. Convalescence from such an operation was long and tedious, six months being not an uncommon time; the results as regards continence were poor, and generally there was recurrence within a few months, although not always. This was the type of operation Herbert Allingham performed at the time when I used to assist him.

The second period was that of Kraske's operation, where an incision was made over the rectum from behind, and part of the sacrum removed. The section of the rectum containing the growth was cut out, and the two ends of the bowel were sewn together again, as well as could be managed, or a sacral anus was established.

Both these methods were only applicable to a few selected cases, and the results were almost invariably bad. Serious sepsis was inevitable after these operations, and the successful cases as regards recurrence were usually those where the subsequent sepsis removed extensions of the growth which the operation failed to do. The mortality was high, and the functional results as a rule were very poor. Many of the patients had a permanently incontinent sacral anus, and often a bad prolapse developed which caused a great deal of trouble. The recurrence figures after Kraske's operation were very unsatisfactory, and the great majority of those patients surviving the operation died of early recurrence. They did not all have recurrence, as I know of several who are alive to the present day.

The abdomino-perineal operation which marks the next period was the first great advance in the surgery of rectal cancer, and was a decided improvement on anything that had gone before. It fulfilled two important factors which had hitherto been lacking—a free removal of the growth and surrounding tissues, and a technique which made it *possible* to eliminate sepsis. At first the operation was designed so as to allow the end of the colon to be brought down to the anus and more or less normal function to be restored; but it was soon found that this added serious dangers to an operation which was already very risky. It is not possible to ensure an adequate blood-supply to the transplanted colon, and this method has now been almost universally abandoned in favour of terminating the operation with a permanent colostomy.

While the operation is a great improvement upon its predecessors, it has certain serious drawbacks as a routine method of removing rectal cancer. The mortality of the operation, even in the hands of experienced operators, is very high—in any large series of cases it is 30 per cent or over, and it cannot be performed on people over 60 years of age, or where there are complicating conditions—in fact, the mortality can only be kept down to at all a reasonable level by a very careful selection of cases. This is a serious drawback, since the majority of cases of rectal cancer occur at ages between 55 and 65, as will be seen by reference to the age tables; and, moreover, many of the patients have some complicating disease. A mortality of anything near 30 per cent cannot be faced with equanimity, and it was in order to get a technique that would allow of satisfactory removal of the growth, and at the same time get rid of the high mortality, that I adopted the perineal operation I now perform as a routine method, and reserved the abdomino-perineal operation for cases otherwise inoperable. The abdomino-perineal operation, or some modification of it, remains the method of choice for growths too high up to allow of removal by the perineal route; but I think that the perineal operation should become the method of choice for all cases of true rectal cancer.

It is obvious that the correctness or otherwise of my contention depends upon the results as regards both the mortality and, more especially, the recurrence rate after the perineal operation; and this paper, which is a description of the whole of the results of 200 consecutive cases, is published with a view to proving the correctness of this statement.

A few months ago I completed my 200th case of perineal resection of the rectum for cancer, and as the cases both in private and in hospital have been as carefully traced as is possible, I think the publication of the results will be of value in showing what the actual results are in a large series of cases, and what may be expected by this operation. Cases where the growth was situated at or above the recto-sigmoidal junction are not included in this series, as they have been dealt with by the abdomino-perineal operation. I would particularly stress this point, as there is a distinct temptation to attempt removal of very high growths by the perineal route owing to the greater ease and safety of this operation. Attempts, however, at removal of a very high growth in the rectum by the perineal route involve the operator in serious difficulties, and discredit the operation, which was never intended to deal with such cases.

The following cases are a complete sequence of 200, of which 100 were operated on in private and 100 in hospital. The period covered by the series is a long one, and includes the development of the technique now employed. Considerable improvement has naturally taken place in the details of the operation and subsequent treatment, so that the results in many ways are better in the later cases. The recurrence figures are worked out only on the earlier cases, as it is only in cases operated upon before or during the first few months of 1921 that a sufficient time has elapsed to judge of the curative results of the operation. In regard to these figures it must be borne in mind that the comparative safety of the operation has resulted in many advanced cases being operated on which would not have been considered justifiable if a more serious procedure was involved; and that for the same reason a large

number of quite old persons have been operated upon, no fewer than 72 patients being over 60 years of age, and these could not have been operated on at all had the abdomino-perineal route been used.

Age.—The following are the ages in the 200 consecutive cases operated on :

Under 30	30–40	40–45	45–50	50–55	55–60	60–65	65–70	Over 70
3	10	10	22	36	47	42	16	14

It will be seen that the age at which the largest number of cases occurred is between 55 and 60, the next commonest the following five years, but that after reaching a maximum at 55 to 65 there is a rapid decline in the number of cases as the age increases. There can be little doubt that this decline is due to the decreased number of persons living over the age of 60, and partly to the fact that at the higher ages a larger number of cases are inoperable on account of their age. The chart (*Fig.* 59) is given to show the age incidence of cancer when taken from a really large number of cases. It is from Dr. Frederick Hoffman's " Mortality of Cancer throughout the World ", and shows, as might be expected, a steadily increasing incidence of cancer with increasing age.

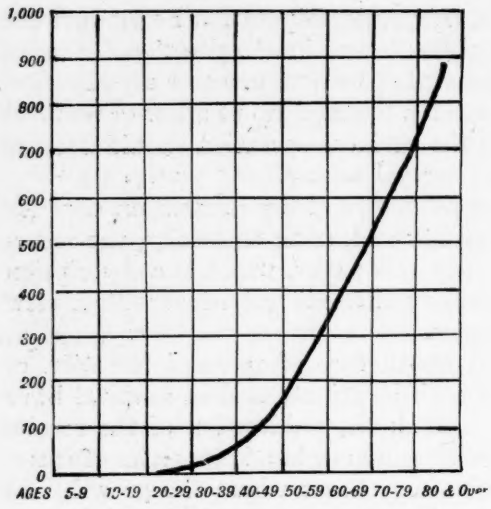

FIG. 59.—Cancer mortality. Age rate per 100,000 population.

My age table demonstrates the value of an operation with a comparatively low mortality risk, as it will be seen that no fewer than 72 patients out of 200 would have been too old for operation by the abdomino-perineal route. As a matter of fact, of the patients over 70, only 2 died as the result of the operation.

Sex.—Of the 200 cases, 123 were males and 77 females. This is in the proportion of 3 males to 2 females, and corresponds very closely to the proportion shown in the Ministry of Health figures for 1925, which work out at 4 males to 3 females.

PREDISPOSING CONDITIONS.

In this series of cases, what would appear to be the most important predisposing cause of the disease, apart from age, is the presence of simple adenomata in the bowel. For the last two years these have been very carefully looked for in all cases of excision, with the result that they were found associated with cancer in all but a very few of the cases examined. It seems probable that in the few cases in which no adenomata were discovered they may have been present higher up in the bowel, since the area examined was necessarily confined to the parts removed (*Fig.* 60). This is borne out by the fact that in one case an adenoma was found on the mucous membrane of the

colostomy. This subject has been extensively dealt with by Dr. Dukes, the pathologist at St. Mark's Hospital, in a paper read before the Proctological Section of the Royal Society of Medicine on Jan. 13, 1926.

In one case (*Fig.* 61) there were two distinct carcinomata in the rectum within half an inch of each other. Sections cut for histological examination from the intermediate submucous tissue fail to show any signs of continuity between the two growths. In this case the presumption is that both growths had arisen simultaneously in simple adenomata previously present.

FIG. 60.—Cancer of rectum removed by perineal excision, showing associated adenomata.

Four cases (Nos. 1, 3, 18, 137) are remarkable in that another primary cancer developed in the same patient after an interval of years. One patient had his rectum removed for cancer, and eighteen years later returned with another small growth in the colon some 8 in. higher up. This also was successfully resected, and he is still alive, now twenty-one years since the original operation. Another patient developed a growth 11 in. higher up in the colon six years after a growth in the rectum had been removed by perineal resection. In neither case was there any evidence that the second growth was a recurrence of the first one. It had all the characteristics of a primary growth, and there were no glands involved nor any signs of secondary deposits. Another patient developed a duct carcinoma of the left breast three years after the removal of the rectum for cancer. The fourth patient also developed a duct carcinoma of the breast two years after the removal of the rectum for adenocarcinoma. This last patient died from recurrence of the breast tumour without showing any signs of secondary growths from the rectal tumour. In addition, there is the patient already mentioned who had two growths present at the same time.

Both clinical and experimental evidence seem to prove that one malignant tumour inhibits the development of another primary growth in the same individual. The cases just quoted would seem to show that the inhibitory action does not always last very long—indeed, it is questionable whether the incidence of cancer in these cases, as shown by four having developed a second growth, is much less than the normal incidence would be for patients of this age who had not had a growth before; but the figures are too few to draw any definite conclusions.

FIG. 61.—Specimen of rectum removed by operation, showing two separate primary growths. Probably arising simultaneously in previously existing simple adenomata, several of which can be seen in the lower part of the specimen. Microscopical sections cut from the submucous layer between the tumours showed no carcinoma cells.

In several cases there was direct evidence that the cancerous growth had developed in a simple adenoma which had been present for a number of years previously. I consider an adenoma of the rectum as a definite precancerous condition, to be dealt with as such.

A specimen of one very remarkable case is shown in *Fig.* 62. This growth was the earliest stage of cancer of the rectum that I have ever seen. The actual growth was a little over $\frac{1}{2}$ in. in diameter, and a section of the entire growth is shown in the figure in section magnified eight times. Histological examination of this growth shows a very strong probability that it started as a simple adenoma.

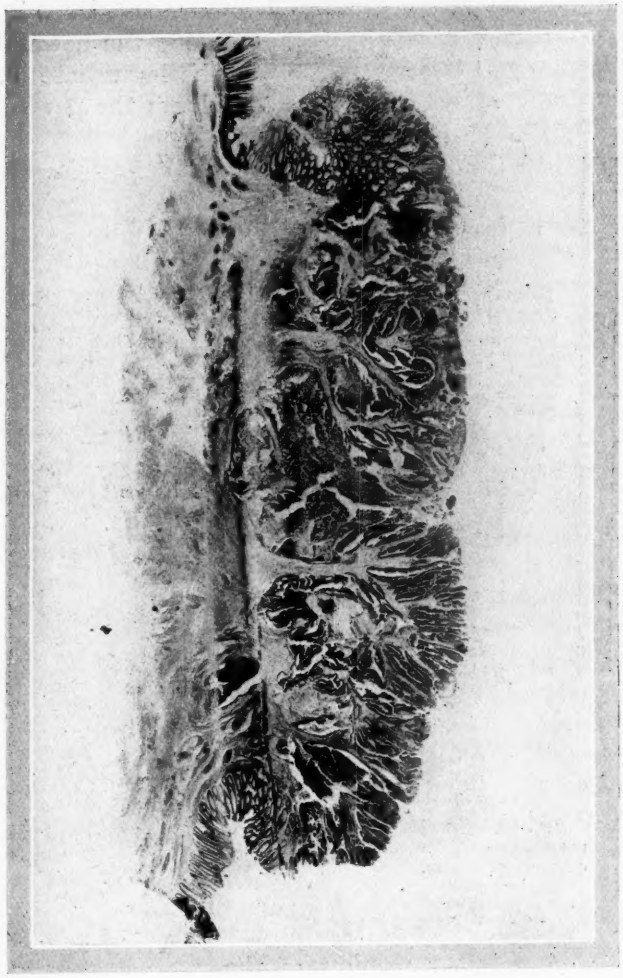

FIG. 62.—A complete cancer of the rectum enlarged eight times. The original specimen was about 1 cm. in diameter, and projected like a little button in the rectal wall.

TISSUES REMOVED BY THE PERINEAL OPERATION.

These consist of the entire rectum and a few inches of the pelvic colon, together with, in one piece, the skin surrounding the anus for an inch or more, the levatores ani muscles together with the pelvic fascia reflected on to them, most of the fat in the ischiorectal space and upper pelvic space between these muscles and the rectum, and the greater part of the mesorectum and all the glands lying in immediate relationship with the bowel. These are the tissues normally removed; but when rendered necessary or advisable from the nature of the case, the posterior part of the prostate gland and vesiculæ seminales can be removed, and in the female the whole of the posterior vaginal wall, and even the uterus.

The actual difference between the amount of tissue removed by this operation (*Fig.* 63) and by the abdomino-perineal route is very slight. A few more of the secondary glands in the base of attachment in the mesorectum and

rather more of the pelvic peritoneum can be removed by the abdominal route; but it is very doubtful if in any case recurrence can be avoided once these secondary glands have become involved. The few more inches of pelvic colon that are resected by the abdominal route probably make no difference as regards recurrence, since it is now known that spread along the bowel itself is very unusual beyond the immediate limits of the growth. *Fig.* 64 shows the parts actually removed.

FIG. 63.—Specimen removed by perineal excision, showing the amount of tissue.

FIG. 64.—Drawing of actual specimen to show the tissues removed by perineal resection. Note the entire rectum and surrounding tissues, including levatores muscles and anal skin. (×⅜.)

THE OPERATION.

A detailed account of the operation will not be given here, as it has already been described several times, and the object of this paper is to analyse the results rather than to discuss the operative technique.

The operation is done in two stages, a permanent colostomy being performed either a week beforehand or at the time of the resection. Either spinal or regional anæsthesia is used, aided by gas and oxygen or twilight sleep.

The patient is placed in the semi-prone position, head down, and if a male a catheter is tied into the bladder. The anus is first closed with a purse-string suture passed subcutaneously with a curved needle, and an incision is made from the base of the sacrum, passing around the anus and about 1 in. from it. The coccyx is removed by dissection, and the deep fascia divided transversely just in front of the sacrum. Both levatores ani muscles are divided close to the pelvic wall with scissors, and the rectum is then dissected off the vagina in the female, or from the urethra and prostate in the male, until the peritoneum is reached. The peritoneum is opened, and as much bowel drawn down as possible. The mesorectum is clamped off as far back as can be managed, and divided. The clamps are tied off, and, after dividing the peritoneal coat of the pelvic colon and stripping it back for a short distance, the bowel is crushed and divided with a cautery. The stump is ligatured and turned in with a purse-string suture, and the wound in the peritoneum closed with catgut stitches. The wound itself is closed without drainage in most cases. In a few a small rubber wick is inserted. The wound is not dressed for forty-eight hours, and then the blades of a pair of dressing forceps are introduced between two of the stitches, and any accumulated fluid allowed to escape. If the wound remains quite clean, it is allowed to heal by first intention ; but if the accumulation of serum continues, a stitch is removed, a small piece of drainage tube is introduced, and the cavity kept irrigated with weak Dakin or Milton solution. The patient is allowed out of bed on the fourteenth day, and is generally able to return home in from three weeks to a month.

Operative Mortality.—In the 100 private cases there were 3 deaths, a mortality of only 3 per cent, while in the 100 hospital cases there were 14 deaths, a mortality of 14 per cent. The very marked difference between the mortality in private and hospital cases is due to several factors. The private cases are, of course, better nursed, as they all have special nurses who have no one else to attend to, while in the hospital the staff is more or less chronically overworked, and the same individual attention cannot be given. Probably a more important factor is that the ordinary hospital patient is not in such good general condition. Hospital patients tend to come up for treatment in a more advanced state of the disease, they are not so well nourished, and are relatively older at the same age as the result of hard work. At any rate they do not seem to have the same recuperative powers as the wealthier classes. It is no doubt a combination of these factors which accounts for the difference. It is now my practice to keep the hospital patients in bed for at least a week, and often longer, before operating, in order to improve their chances, and this seems to have considerably improved the mortality risk.

I think it is fair to claim that a 3 per cent operative risk is as good as can be hoped for in any operation for the removal of the rectum ; more particularly as the cases have been in no sense picked ones, any cases where there seemed to be a fair possibility of safe removal having been submitted to operation, irrespective of age and associated disease. Thus no fewer than 72 patients were over 60 years of age, and 14 were over 70. As regards associated disease, 2 cases had Graves' disease, 1 had Hodgkin's disease, 3 had diabetes, 3 had diverticulitis, 1 woman of 48 had an aortic aneurysm, 1 man had hæmophilia.

Causes of Death.—Of the three deaths which occurred in the private cases, two were from heart failure and one from chronic sepsis. Their respective ages were 63, 75, and 54.

The deaths from the hospital cases were as follows: sepsis, 6; pulmonary embolism, 1; hæmorrhage (one case of hæmophilia), 2; shock, 1; pyelonephritis, 1; dilatation of the stomach, 1; pneumonia, 2.

I do not think that it is possible to keep the mortality figures for the hospital cases as low as in the private cases, though considerable improvement is no doubt possible. Even at the present time nearly 80 per cent of all the patients coming up to the hospital for treatment are quite inoperable when first seen, and it is the very late stage at which these patients submit themselves for treatment, rather than anything else, which diminishes their chances, as against the private cases, who are seen earlier.

RECURRENCE FIGURES.

I think I have been able to show that the operation risk is as low as can be hoped for from any operation for resection of the rectum; and the value of the method, therefore, depends upon its ability to cure the patient from the disease, as evidenced from the recurrence rate. It is usual to work out recurrence rates on a three-years basis; but I have always considered that this is much too short a period, as unoperated cases often live as long as this. A five-years basis is much better, though this, too, is not really long enough. The difficulty, however, of working out figures for any period longer than five years is so great that I do not think one can take anything beyond a five-years basis. The following figures have been worked out on the basis of patients surviving the operation a clear five years. There were 95 cases operated on over five years ago. These work out as follows:—

	Cases
Cures on 5-years basis	45
Recurrences	37
Died from other causes during the 5 years	6
Untraced cases	7
Total	95

If we subtract the untraced cases and those that died of other causes, i.e., 14 cases, it gives us 82 cases with 45 cures, or a percentage of cures on a five-years basis of 54·8. If, instead of subtracting the untraced cases and 'died from other causes' cases, we divide these into their probable recurrence rate, which would be roughly 50 per cent, and add 7 cases to the cures, this would make 95 cases with 51 cures, or a percentage of 53·6 cures.

Taking a three-years basis instead of a five-years, there are 125 cases, with 73 cures and 42 recurrences, which gives 55·5 per cent cures. The chances, therefore, of a patient being alive five years after the operation are over 50 per cent.

If we now examine these figures in a little more detail we find several interesting points. All the cases were originally divided into three classes, marked in the table—A, B, and C.

A: very favourable cases where the growth was small and had not apparently invaded the muscular coat, and no glands were involved.

B: medium cases where there was involvement of the muscular coat, but where the growth was not unduly fixed and there was no extensive involvement of glands.

C: very bad cases, where the growth was large and fixed, or where there was evidence of extensive involvement of glands. These were borderline cases with a bad prognosis.

Out of a total of 200 cases there were: 73 A cases, 96 B cases, 31 C cases. An analysis of these three classes as regards recurrence is very interesting. Taking only the cases which were operated on over five years ago, and leaving out untraced cases and deaths from other causes, we find that the result is as follows:—

Cases	Total	Cures, 5-years Basis	Recurrences	Percentage Cure
A cases	30	22	8	73·7
B ,,	43	19	24	44·1
C ,,	9	4	5	44·4

N.B.—The untraced and those who died of other causes have been subtracted from the totals.

This shows that with picked favourable cases the percentage of cures on a five-years basis is very high. The pity is that more cases are not operated on at this stage. The figures for the C cases are doubtless misleading, as they are too few; but they show one very important point, namely, that such cases are well worth operating upon. These C cases all showed such extensive growth that recurrence seemed probable, and yet there were four cases which survived the five-year period, one even surviving 18 years. The argument deduced from this is that growths differ very much as regards their liability to recurrence after removal. There is at present no means of estimating this liability in any individual case, nor do we know the reasons for it. A certain number of apparently hopeless cases never get a recurrence, while some of the most hopeful ones do. It is this fact which is the strongest argument against extensive block resections as a routine treatment for carcinoma. While we should always remove the growth as freely as possible, compatible with reasonable safety, the facts do not seem to justify very extensive removal when this entails serious additional risk.

Thirty-nine of the cases have been traced beyond the five-years period, and the following table shows what happened to them:—

Table of 39 Cases Traced beyond 5 Years, showing the Number of Years that have Elapsed since Operation.

Cases	Years	Cases	Years
1	21	3	9
2	14	7	8
2	11	8	7
3	10	13	6

N.B.—Out of these 39 who lived beyond the 5 years, 5 died between the 5th and 7th years from recurrence, but there are no known recurrences in any patients surviving beyond this period.

DISABILITY PRODUCED BY OPERATION.

When dealing with so serious and fatal a disease as cancer, disability after operation is a relatively unimportant factor. It becomes important, however, when comparing one method of treatment with another.

The disability which results from the perineal operation is entirely due to the presence of a permanent colostomy opening in place of the normal anus. This is, of course, also true of the abdomino-perineal operation. This disability is not a serious one—in fact, not nearly so serious as might well be imagined. Patients are able to live comfortable and useful lives, and after the first few months it is remarkable how little inconvenience the colostomy causes.

The best way, perhaps, to estimate the disability is in reference to the wage-earning capacity of hospital patients. We find that this is not diminished except in the case of very heavy labour involving strenuous exertion. The vast majority of patients were found to be still in the same employment as formerly. Thus, out of 20 cases apparently cured by operation, 6 were women, 5 of whom did their housework, and 1 was a stationer's assistant. There were 14 men, of whom 10 were in full work in the following occupations: printer's cutter, fish-curer, schoolmaster, packer, tailor, pilot, messenger, waiter, platelayer, and odd-job man. Three were living in retirement, being over 65 years of age; and one, who used to be a farm labourer, no longer works.

CONCLUSIONS.

These figures show that when the operation is performed under the most favourable conditions the mortality is only 3 per cent, and that the percentage of cures on a five-years basis is 50 per cent; while where specially favourable, picked cases alone are dealt with, the proportion of cures on a five-years basis reaches the very high figure of 73 per cent. This compares most favourably with cancer of the breast or any other organ.

It is only by the collection of a large number of cases and publication of the results that we can arrive at any satisfactory judgement of the merits of any operation. That no statistics of this character are entirely satisfactory must be admitted, for they do not show the whole truth. The proper way in which such statistics should be worked out is to take, say, 500 consecutive cases of cancer presenting themselves for treatment, and show the number of cases operated upon, the operative mortality, and the percentage of cures, based on the original 500 cases. Such tables, if they could be worked out (as a matter of fact they cannot, as a large number of inoperable cases do not reach the surgeon at all), would form a useful guide as to the relative merits of different operative procedures. Unfortunately, they would show such a relatively low percentage of cures out of the total that they would be depressing reading.

It is to earlier diagnosis that we must look for any material improvement in our cancer cures from operation.

TABLE SHOWING RESULTS AND SUBSEQUENT HISTORY OF THE 200 CASES.

A = Very favourable. B = Medium cases. C = Border-line cases. D = Death from operation. R = Recovery from operation.

PRIVATE CASES.

Case	Year of Operation	Sex and Age	Type of Case and Result	Length of Survival and Remarks
1	1905	M. 37	C. R.	21 years: in 1923 a new growth occurred in upper part of rectum; the second growth was excised
2	1912	M. 60	A. R.	14 years
3	1913	F. 68	A. R.	8 years: 4 years after had duct cancer of breast, which was removed; died in 1921 of apoplexy
4	1915	M. 60	B. R.	7 years: died of heart disease in 1922
5	,,	M. 62	C. R.	5 years: died of cerebral disease
6	1916	M. 52	A. R.	2 years: died of recurrence
7	,,	F. 75	A. R.	6 months: died of pleurisy
8	,,	M. 63	C. R.	2 years: recurrence in liver
9	,,	M. 52	B. R.	9 months: died of recurrence
10	,,	M. 43	A. R.	9 years
11	1917	M. 66	B. R.	9 years
12	,,	M. 67	B. R.	2 years: died of pneumonia
13	,,	M. 52	B. R.	2 years: recurrence
14	,,	F. 63	B. R.	2½ years: recurrence in pelvis
15	,,	M. 68	B. R.	6 months: probably recurrence
16	,,	M. 68	A. R.	Alive 5 years, untraced later
17	,,	M. 57	A. R.	8 years
18	,,	M. 53	A. R.	7 years: died of a second primary growth in colon which recurred after removal
19	,,	M. 57	A. R.	8 years
20	1918	M. 55	B. R.	8 years
21	,,	F. 40	C. R.	6 years: recurrence in vagina
22	,,	F. 62	A. R.	2 years: recurrence
23	,,	F. 58	B. R.	Alive 3 years later, but had recurrence
24	,,	M. 50	B. R.	Alive 4 years later, but had recurrence
25	,,	F. 50	B. R.	Alive 3 years, but recurrence in colon
26	,,	F. 36	B. R.	1 year later, recurrence in vagina
27	,,	F. 70	B. R.	1 year: died from coma; no local recurrence
28	,,	F. 56	A. R.	7 years (had Graves' disease for 20 years)
29	1919	F. 44	B. R	2 years: recurrence in lumbar glands
30	,,	M. 56	B. R.	7 years
31	,,	M. 72	B. R.	6½ years
32	,,	M. 51	B. R.	6½ years: died of recurrence
33	,,	M. 64	B. R.	6 years (had Hodgkin's disease at time of operation)
34	,,	M. 54	B. R.	6 years
35	1920	F. 54	C. R.	4 years: died of recurrence
36	,,	F. 52	B. R.	6 years
37	,,	F. 42	A. R.	1 year: recurrence
38	,,	F. 60	B. R.	6 years
39	,,	F. 43	A. R.	6 years
40	,,	M. 51	C. R.	1 year: recurrence in lumbar spine
41	,,	F. 63	B. R.	4 years: recurrence in liver
42	1921	M. 72	A. R.	5 years
43	,,	M. 61	B. R.	5 years
44	,,	F. 54	B. R.	2 years: recurrence
45	,,	M. 61	A. R.	5 years
46	,,	M. 52	A. R.	4 years
47	,,	F. 53	C. R.	4 years
48	,,	M. 62	A. R.	2 years: recurrence
49	,,	M. 69	A. R.	4 years: died of 'seizure'; no recurrence

[*Continued on next page*

RESULTS AND SUBSEQUENT HISTORY—*continued.*

Case	Year of Operation	Sex and Age	Type of Case and Result	Length of Survival and Remarks
50	1921	M. 60	A. R.	4 years: died of recurrence
51	,,	F. 58	A. R.	3 years: died of recurrence (had Graves' disease)
52	1922	M. 51	C. R.	Few months later local recurrence, died after X-ray burn
53	,,	M. 47	B. R.	3 years: alive in 4th year but has recurrence
54	,,	F. 46	A. R.	4 years
55	,,	F. 39	C. R.	2 years: recurrence
56	,,	M. 63	C. D.	Sepsis
57	,,	M. 38	A. R.	3 years: died 4th year, recurrence in liver
58	,,	M. 46	A. R.	4 years
59	,,	F. 47	B. R.	3 years: recurrence
60	,,	F. 75	C. D.	'Heart failure' 3 weeks after operation
61	,,	M. 56	B. R.	3 years
62	1923	M. 45	B. R.	2 years: recurrence
63	,,	M. 64	A. R.	3 years
64	,,	F. 54	B. D.	'Heart failure'
65	,,	M. 64	A. R.	3 years
66	,,	F. 63	A. R.	3 years
67	,,	M. 59	A. R.	Died 1 year later of recurrence (had diabetes and diverticulitis)
68	,,	F. 60	A. R.	3 years
69	,,	F. 70	B. R.	3 years: diabetes
70	,,	F. 68	C. R.	1 year: recurrence
71	,,	F. 63	B. R.	3 years
72	,,	M. 69	B. R.	1 year: recurrence in liver
73	,,	F. 60	A. R.	Alive to date
74	,,	F. 50	A. R.	,, ,,
75	,,	M. 56	A. R.	,, ,,
76	,,	M. 72	B. R.	,, ,,
77	,,	F. 58	B. R.	,, ,,
78	1924	M. 73	B. R.	,, ,,
79	,,	M. 62	B. R.	,, ,,
80	,,	M. 65	B. R.	,, ,,
81	,,	F. 59	B. R.	,, ,,
82	,,	F. 71	B. R.	,, ,,
83	,,	M. 64	B. R.	,, ,,
84	,,	M. 59	B. R.	,, ,,
85	,,	M. 64	B. R.	,, ,,
86	,,	M. 67	B. R.	,, ,,
87	,,	F. 61	A. R.	,, ,,
88	,,	F. 56	A. R.	,, ,,
89	,,	M. 56	A. R.	,, ,,
90	1925	F. 62	A. R.	,, ,,
91	,,	F. 58	B. R.	,, ,,
92	,,	M. 55	A. R.	,, ,,
93	,,	F. 58	A. R.	,, ,,
94	,,	F. 52	A. R.	,, ,,
95	,,	M. 73	A. R.	,, ,,
96	,,	F. 75	B. R.	,, ,,
97	,,	M. 65	C. R.	,, ,,
98	,,	F. 71	C. R.	,, ,,
99	,,	F. 58	C. R.	,, ,,
100	,,	M. 72	A. R.	,, ,,
			HOSPITAL CASES.	
101	1910	M. 56	B. R.	Untraced
102	1911	M. 59	A. R.	14 years
103	1912	M. 61	C. R.	1 year: recurrence

RESULTS AND SUBSEQUENT HISTORY—*continued.*

Case	Year of Operation	Sex and Age	Type of Case and Result	Length of Survival and Remarks
104	1913	F. 59	B. R.	Died of recurrence
105	,,	M. 58	B. R.	Untraced
106	,,	M. 62	A. R.	,,
107	1914	M. 53	B. R.	6 years: recurrence
108	1915	M. 49	B. R.	11 years
109	,,	M. 61	B. R.	1 year: died of tuberculosis
110	,,	M. 50	B. R.	11 years
111	,,	F. 43	B. R.	2½ years: recurrence
112	,,	F. 45	B. D.	Shock
113	1916	F. 62	A. R.	10 years
114	,,	M. 68	B. D.	Sepsis
115	,,	M. 35	C. D.	Hæmorrhage (hæmophiliac)
116	,,	M. 54	B. R.	1 year: recurrence
117	,,	M. 46	B. R.	2 years: recurrence in liver
118	,,	F. 53	A. R.	10 years
119	,,	M. 52	B. R.	10 years
120	,,	M. 48	B. R.	1 year: recurrence
121	,,	M. 48	A. R.	9 years
122	1917	M. 64	B. D.	Sepsis 4 weeks after operation
123	,,	F. 34	A. R.	Alive 5 years later, but had recurrence
124	,,	F. 62	C. D.	Sepsis
125	,,	M. 35	A. R.	3 years: untraced later
126	,,	M. 58	A. R.	8 years
127	,,	M. 59	A. R.	8 years
128	,,	M. 50	A. R.	Untraced
129	,,	F. 43	A. R.	3 years: recurrence
130	1918	M. 45	B. R.	6 years: recurrence in liver
131	,,	M. 57	B. R.	2 years: died of recurrence
132	,,	F. 48	B. R.	8 years
133	,,	M. 47	B. R.	Died of recurrence in 3rd year
134	,,	M. 47	A. R.	2 years: died of cerebral hæmorrhage: no recurrence
135	,,	M. 60	A. R.	7 years
136	,,	M. 54	A. R.	3 years: recurrence in liver
137	,,	F. 48	C. R.	5 years: died of cancer of breast
138	,,	F. 57	C. R.	1 year: recurrence
139	,,	M. 50	A. R.	2 years: recurrence
140	,,	M. 62	A. R.	Untraced since 1920
141	,,	M. 57	A. R.	7 years
142	1919	M. 66	A. R.	7 years
143	,,	M. 50	A. R.	1 year: recurrence
144	,,	F. 26	A. R.	Untraced
145	,,	F. 60	B. R.	Recurrence 2 years later in vagina, died 4 years later
146	,,	M. 46	A. R.	7 years
147	,,	M. 29	A. R.	1 year: recurrence
148	,,	F. 56	B. R.	9 months: recurrence
149	,,	F. 59	B. R.	18 months: recurrence
150	,,	M. 54	B. R.	2 years: recurrence
151	,,	F. 63	C. D.	Ascending pyelonephritis after cystitis
152	,,	F. 48	B. D.	Sepsis
153	1920	M. 66	B. R.	6 years
154	,,	F. 61	B. R.	1 year; recurrence (had diverticulitis)
155	,,	M. 52	C. R.	6 years
156	,,	M. 59	B. R.	6 years
157	,,	M. 63	B. R.	1½ years: recurrence
158	1921	M. 57	B. D.	Sepsis
159	,,	F. 43	B. R.	2 years: recurrence in liver
160	,,	M. 55	B. D.	Sepsis
161	,,	F. 59	B. R.	4 years

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RESULTS AND SUBSEQUENT HISTORY—*continued.*

Case	Year of Operation	Sex and Age	Type of Case and Result	Length of Survival and Remarks
162	1921	F. 53	B. R.	2 years: recurrence in liver
163	,,	M. 28	C. R.	2 years: recurrence
164	1922	M. 56	B. R.	3 years, untraced later
165	,,	M. 58	B. D.	Bronchopneumonia
166	,,	F. 48	C. R.	4 years (had aortic aneurysm)
167	,,	M. 59	B. D.	Pulmonary embolism
168	,,	F. 53	B. R.	4 years
169	,,	F. 38	B. R.	4 years
170	,,	F. 64	C. R.	2 years: recurrence in groin (had diverticulitis)
171	,,	M. 66	A. R.	3 years
172	,,	M. 54	B. R.	1½ years: recurrence in liver
173	,,	F. 72	C. D.	Pneumonia
174	,,	F. 74	B. R.	1 year: recurrence in liver
175	,,	F. 66	B. R.	3 years
176	,,	F. 59	B. R.	3 years
177	,,	F. 56	B. R.	3 years
178	,,	M. 60	A. R.	Alive to date
179	,,	M. 61	A. R.	,, ,,
180	,,	M. 53	C. R.	,, ,,
181	,,	F. 66	B. R.	Had diverticulitis: alive to date
182	,,	M. 65	A. R.	Alive to date
183	1924	F. 56	B. R.	,, ,,
184	,,	F. 53	A. R.	,, ,,
185	,,	M. 63	B. R.	,, ,,
186	,,	F. 60	C. D.	Hæmorrhage
187	,,	M. 40	C. R.	Alive to date
188	1925	F. 65	B. R.	,, ,,
189	,,	M. 51	A. R.	,, ,,
190	,,	M. 63	B. R.	,, ,,
191	,,	M. 64	B. R.	,, ,,
192	,,	M. 58	A. R.	,, ,,
193	,,	M. 55	B. R.	,, ,,
194	,,	M. 73	C. D.	Dilatation of stomach
195	,,	M. 60	A. R.	Alive to date
196	,,	M. 62	A. R.	,, ,,
197	,,	M. 51	C. R.	,, ,,
198	,,	M. 51	A. R.	,, ,,
199	1926	M. 63	A. R.	,, ,,
200	,,	M. 63	B. R.	,, ,,

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THE ETIOLOGY OF CONGENITAL INGUINAL HERNIA AND ABNORMALLY PLACED TESTES.

By RICHARD H. HUNTER, Belfast.

It is said by Keith[1] that the transition of the testis from the abdomen to the scrotum is brought about by the atrophy and contraction of the gubernaculum; but if this strand of tissue is to pull on the testis it must have a fixed point from which to act, and such a point is absent in the human fœtus. The testis of a newly-born infant with the processus vaginalis and its fascial coverings can be lifted out of the scrotum without tearing anything but a little superficial connective tissue, the gubernaculum being attached to the deep aspect of the fascial coverings of the testis, which separate it from the skin of the scrotum (*Fig.* 65).

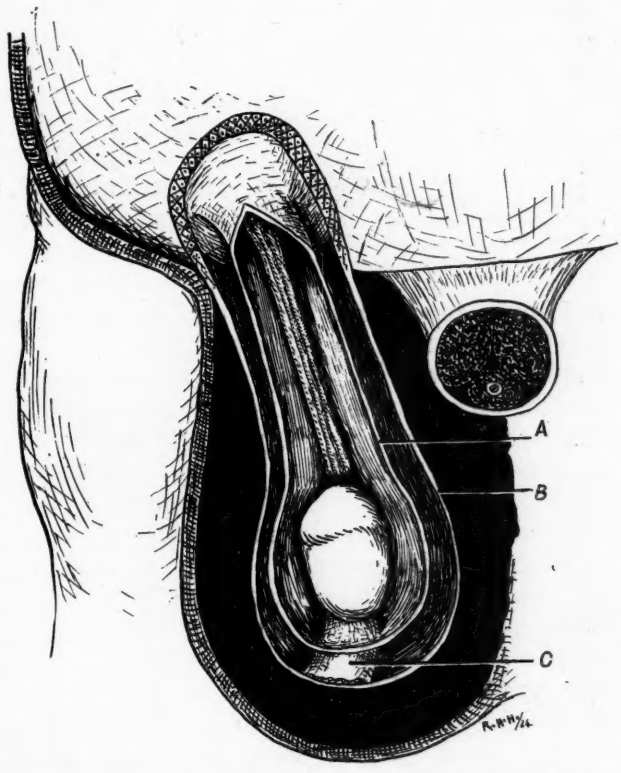

Fig. 65.—Dissection of the scrotal region of a newly born infant, showing the arrangement of the fascial coverings. Note the position of the gubernaculum, which is not attached to the skin of the scrotum. A, Processus vaginalis, cut edge; B, Fascial coverings, cut edge; C, Gubernaculum.

At an early stage in development the genital gland of each side is united to the deep aspect of the anterior abdominal wall by a fold of peritoneum termed the inguinal fold (*Fig.* 66). A condensation of mesenchyme—the anlage of the gubernaculum—occurs between the layers of this fold, passing from the lower pole of the genital gland, mesonephros, and Wolffian duct, through the abdominal wall, to end in an indefinite manner in the neighbourhood of the genital tubercle. This cord of tissue is present in the 13-mm. human embryo, i.e., at a stage before the abdominal musculature is differentiated. When the latter begins to form it must grow around the cord, and the inguinal canal must therefore contain the gubernaculum from the beginning.

About the middle of the 12th week the gubernaculum grows rapidly, and the part immediately below the testis becomes bulbous, and spreads out in a fan-shaped manner into six separate strands. One of these strands ends near the saphenous opening, one passes upwards towards Poupart's ligament, one passes towards the pubis, one to the root of the penis, one to the perineum, and one towards the scrotum. These strands are unequal in size, and normally in the human subject the largest strand passes to the scrotum.

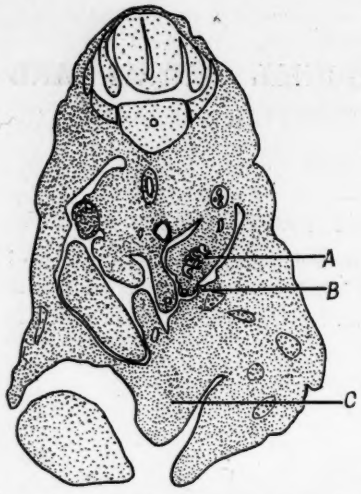

FIG. 66.—Transverse section of human embryo of 20-mm. crown-rump length, showing the position of the inguinal fold. A, Mesonephros; B, Inguinal fold; C, Genital tubercle.

The gubernaculum reaches its greatest development about the middle of the 6th month, and then gradually becomes smaller and less easily defined, until at birth all the fibres have disappeared except the large strand passing to the scrotum.

At the 20-mm. stage in the human embryo (*Fig.* 67) round growing cells are to be seen streaming outwards from the neighbourhood of the genital gland, along the largest strand of the elongated gubernacular cells, towards the genital tubercle—the scrotal area—and, with the appearance of these cells, the processus vaginalis begins to form as an outpocketing of peritoneum, following in the same direction.

The processus vaginalis increases in length until the beginning of the 7th month, when growth apparently ceases. The apex of the cone-shaped processus at this time reaches the level of the junction of the scrotum and the anterior abdominal wall, and the large growing cells begin to disappear.

During this time changes have been occurring in the position of the testis itself. At the early 5th month, when the growth of the gubernaculum is at its height, the upper pole of the testis is on a level with the lower border of the first sacral vertebra. At the beginning of the 7th month, after atrophy of the gubernaculum has begun, the testis rises to the level of the upper border of that vertebra; but in the 8th month it again passes downwards to the level it occupied at the 5th month, with its lower pole lying within the opening of the processus vaginalis—another proof that the testis is not drawn down by the atrophy of the gubernaculum.

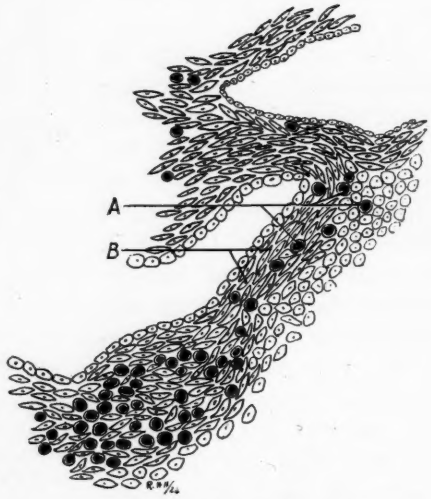

FIG. 67.—Drawing made with the camera lucida to show the position of the large growing cells (A) wandering out along the strand of elongated gubernacular cells (B), in the inguinal fold of a 20-mm. human embryo.

About the 6th month of fœtal life the large intestine is a simple tube; but soon the gut enlarges, becomes distended with meconium, and relatively larger than the same gut in the adult. As development proceeds, the gut enlarges still further, and *pari passu* the intra-abdominal pressure increases until the middle of the 8th month, when it would appear to be raised to such a point that the testis is forced out of the abdomen into the processus vaginalis, through the inguinal canal to the scrotum.

This view, that the testis is forced from the abdominal cavity into the scrotum by the intra-abdominal pressure, is in complete agreement with that of Bland-Sutton,[2] who many years ago described the phenomenon as an evolutionary or developmental herniation which occurs after the formation of a complete diaphragm when high degrees of intra-abdominal pressure are produced with the evolution of an active life involving running and jumping. Such methods of progression generate strains and stresses[3] within the animal's own body, the changes of intra-abdominal pressure being brought about by the fore-limbs and hind-limbs being in opposite phases of motion. The two halves of the elongated trunk are upheaved when their respective limbs are brought into contact with the earth, and depressed in the interval of time between successive contacts.

FIG. 68.—Diagram illustrating the changes in the processus vaginalis during the descent of the testis.

The peritoneum adheres intimately to the proper fibrous tunic of the gland, so that when the testis passes from the abdomen to the scrotum it carries the loosely folded peritoneum of the iliac fossa with it (*Fig.* 68). Just before this occurs, the apex of the processus vaginalis reaches the point where the scrotum and the anterior abdominal wall meet; but after the testis descends, it reaches the most dependent part of the scrotum. This apparent increase in length of the processus is due to the drawing down of the iliac peritoneum, a movement that can be demonstrated on a fresh fœtus which has not been treated with any preservative or hardening reagent, if an opening is made in the abdominal wall, the testis grasped with a pair of forceps, and a pull made towards the scrotum.

Then, again, if the peritoneal cavity of a fresh unhardened fœtus be injected with a thin solution of gelatine, the effect on the testis of raising the intra-abdominal pressure can be directly observed.

In the younger stages, before the full formation of the processus vaginalis, at the period when the gubernaculum is still growing and invaginating its deep layer and partially occluding its lumen, the testis does not pass into the scrotum, but acts like a plug at the abdominal opening of the processus vaginalis (*Fig.* 69). From the middle of the 7th month, however, when active growth of the processus ceases and the gubernaculum begins to atrophy,

the testis passes from the abdominal position through the inguinal canal to the scrotum.

It has been suggested that, as the intra-abdominal pressure is a fluid one, it cannot have a selective action on the testis, and cause it alone to move.[4] This would be a sound criticism were it not for the fact that each testis is lying in a gutter of peritoneum, just at the entrance of the inguinal canal; and although the pressure within the abdomen is a fluid pressure, acting in all directions with the same force, it causes the testis to move, because each testis lies at the preformed internal opening of the inguinal canal.

In discussing the development of the gubernaculum and the processus vaginalis, it was seen that the latter follows the direction of the former. In the human fœtus the largest bundle of the gubernaculum normally passes to the scrotum; but if any of the other bands should be the largest, then the processus will pass in a corresponding direction, and in turn the testis will take up an abnormal position—in the perineum, root of penis, symphysis pubis, fossa ovalis, or over Poupart's ligament.

A study of comparative anatomy would appear to prove this statement, for in marsupials the largest bundle of the gubernaculum passes to the pre-penile position, and normally the testis is found in that position in the adult. In the pig the largest bundle of the gubernaculum may be traced to the perineum, and the testis of that animal is normally found there.

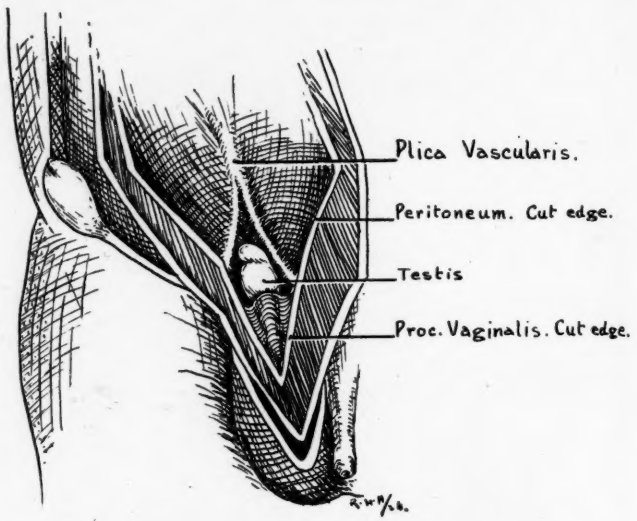

FIG. 69.—Dissection of 7th-month human fœtus showing position of testis in the gutter-like opening of the processus vaginalis, just before descent.

These are the conditions found when the processus vaginalis is developed to its usual size; but if development is arrested before this has occurred, the testis will be unable to reach its usual position, and only a partial descent of the testis results. Every surgeon knows the shortness of the peritoneal processus in such cases when he attempts to bring the testis down to its normal place in the scrotum. This condition, however, must not be confused with the relatively common form of partial descent where the testis lies just at the external abdominal ring and is found at operation to be held in that position by a sac of peritoneum, folded either upwards, outwards, and towards the anterior superior iliac spine over the abdominal wall, or upwards and medially towards the pubic region, a condition due to the large growing cells wandering away from any of the recognized routes, and carrying the sac over Poupart's ligament, folding it over the latter, and preventing the testis passing beyond the external ring.

When the testis gains its scrotal position the processus vaginalis communicates with the general peritoneal cavity, but in the human subject the cavity of the processus normally becomes obliterated between the internal abdominal opening and the upper pole of the testis. This part is known as the funicular portion of the processus, and, when the obliteration is complete, a congenital hernial sac does not exist; but when the obliteration of this part does not occur, a hernial sac of what I shall call *Type a* (*Fig.* 70) results. If partial obliteration only occurs, there is formed the partial funicular hernial sac shown in *Type b*.

The apex of the processus vaginalis normally reaches to the point of junction between scrotum and anterior abdominal wall; but when the testis passes to the scrotum, it carries with it just sufficient iliac peritoneum to reach its fundus. If, however, growth has been excessive, and the processus has reached a point beyond the normal, then there is more peritoneum present

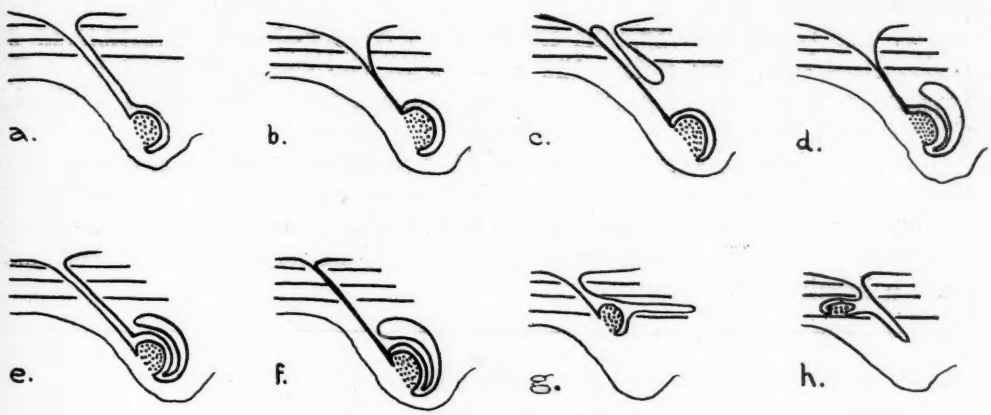

FIG. 70.—Diagram illustrating various types of hernial sacs.

than is necessary for this space, and the extra peritoneum becomes folded upon itself. This may occur in one of two ways:—

1. If there is only a small excess of peritoneum, *Type c* will result, with or without obliteration of the funicular portion. This is the commonest form of hernial sac found in children.

2. If a large excess of peritoneum is present, the surgeon finds *Type e* at operation. The funicular portion in this case may become completely occluded except for the folded portion over the testis, and a potential hydrocele of *Type f* results; or, again, it may become partially occluded, and a hydrocele with a partial funicular hernial sac of *Type d* results.

Some of the large growing nucleated cells may wander between the muscles of the abdominal wall and produce secondary pockets of peritoneum, or interstitial hernial sacs, as shown in *Type g*. The sac of this form of hernia may lie between any two muscles of the abdominal wall, or between the transversalis muscle and the subperitoneal fat, or between the external oblique and subcutaneous fascia. These hernias are usually associated with some interference with the complete descent of the testis to the scrotum, and

may appear as such a variation as that shown in *Type h*, where the testis is placed interstitially, and the apex of the hernial sac just beyond the level of the external abdominal ring.

CONCLUSIONS.

1. The testis, processus vaginalis, gubernaculum, and fascial coverings can be lifted out of the scrotum of a newly-born infant without tearing anything but a little superficial connective tissue.

2. The gubernaculum therefore is not attached to the skin of the scrotum, and the testis cannot be drawn from the abdominal cavity to the scrotum by its contraction.

3. The gubernaculum at first acts as a kind of anchor to the testis; its largest strand normally passes to the scrotal region in the human fœtus and forms the path for the large growing cells which cause the growth of the processus vaginalis.

4. The processus vaginalis develops as a cone-shaped diverticulum of peritoneum, and, just before the descent of the testis, its apex normally reaches to the point of junction between the anterior abdominal wall and the scrotum.

5. During the descent of the testis the peritoneum, which is adherent to the proper fibrous tunic of the gland, is drawn down into the scrotum.

6. If the processus vaginalis is longer than normal before the testis descends, the excess of peritoneum present will become folded upon itself and form a hernial sac.

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THE TREATMENT OF CANCER OF THE ŒSOPHAGUS.

By A. LAWRENCE ABEL, London.

(*Being a Hunterian Lecture delivered before the Royal College of Surgeons of England on February* 10, 1926.)

In the following paper it is my purpose to prove that cancer of the œsophagus can and should be diagnosed at an early date after its commencement; that it is a relatively benign, mild type of malignant growth; that radium, X rays, and diathermy are of very little value in the treatment of the disease. Our attempts at surgical treatment of cancer of the œsophagus have been influenced by our great reliance upon the peritoneum in abdominal surgery; but the œsophagus, like the pharynx, is a very special region in surgery because of septic infection and the absence of any covering analogous to peritoneum. It is my purpose to prove that the operations planned and suggested and put forward are feasible, and that on the face of them there is no physical or pathological reason why they should not be followed by success. And, lastly, drawing analogy from other operations which have only been in use for a few years, all that remains is to add the little fine points of technique by which a perfect operation with a high percentage of cures is obtained.

DIAGNOSIS.

Cancer of the œsophagus is a common disease, one case in every twenty of malignant growth being situated in the gullet. It occurs most commonly in men in the prime of life between the ages of 55 and 60, but it has been known to occur in a child of 14 years and in patients over 90. For every six or seven men affected the disease appears in only one woman.

Symptomatology.—The symptoms of a developed case—namely, dysphagia, discomfort in the chest relative to swallowing, and vomiting, or, more accurately, regurgitation of food—are well known, and instead of describing these I wish especially to emphasize the early or insidious symptoms of the disease. It is unfortunately uncommon to see a case of carcinoma of the œsophagus in its earlier stages, and in fact the average duration of symptoms before a case comes to the surgeon is from six to eight months. This is for two reasons: firstly, because the patient does not pay attention to the earlier symptoms; and secondly, because the majority of the medical public do not recognize the significance of these symptoms, or if they do recognize them, do not know that life may be saved, or at any rate prolonged, by prompt surgical interference.

The first symptom is not always dysphagia, and usually the patient notices for some weeks or months that there is a sense of oppression or weight beneath the sternum. It is important to emphasize that actual pain is conspicuous by its absence, and the sense of discomfort is due to the slight dilatation of the œsophagus from the early narrowing of its lumen, together with

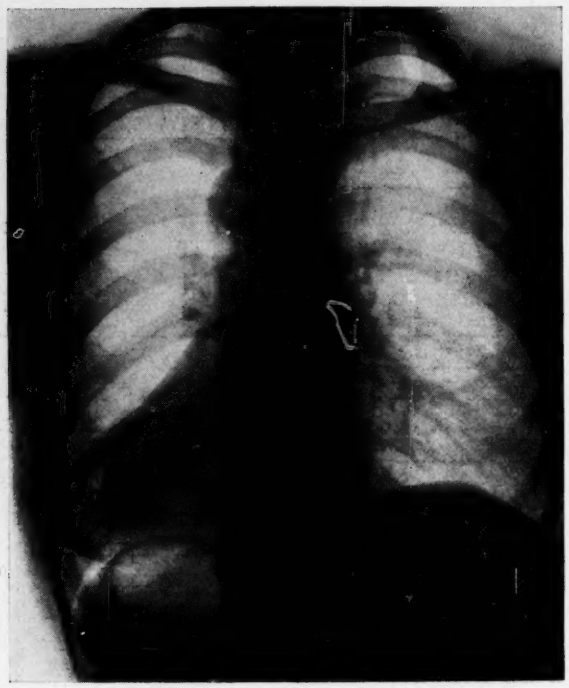

FIG. 71.—Cancer of the œsophagus. The radiogram was taken in the anteroposterior plane and shows the poor definition of the œsophagus on account of the opacity of the mediastinum.

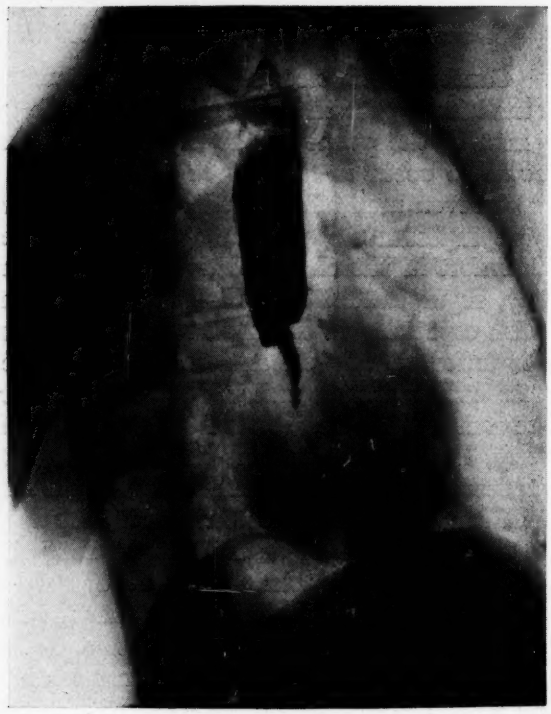

FIG. 72.—Cancer of the œsophagus. The picture shows the clear outline of the shadow made by the opaque drink when the radiogram is taken obliquely through the thorax.

colicky sensations of oppression due to increased muscular contractions of the organ. These sensations are usually noticed when swallowing is attempted, but may be present independently of deglutition. Then the patient finds that, in order to overcome the sense of fullness while eating, he has to take considerable draughts of fluid with his meals in order to wash the food into the stomach. At last there is a distinct obstruction to the passage of food.

In nature the dysphagia is essentially progressive, at first being noticed with solids, later with semi-solids, and lastly with liquids.

Physical Examination.—It has to be emphasized that a most careful general clinical examination must be undertaken. The presence of metastases, although aiding in the actual diagnosis of cancer, signifies at the same time that the case has progressed beyond the possibility of a radical cure.

FIG. 73.—Radiogram of a case of cardiospasm, showing regular outline of œsophagus.

The next step is the performance of a laryngoscopy in order to exclude any lesion of the pharynx or larynx. It is inadvisable to pass a bougie at this stage of the examination, and recourse should be had forthwith to radiography by means of the fluorescent screen, and the most satisfactory position is obliquely through the thorax. Having excluded any other abnormality of the thorax, a barium drink is given, and its passage down the gullet carefully observed with special attention to the presence, site, or degree of any delay or obstruction. These facts can be ascertained better by radioscopy than by radiography, and the patient may be rotated so that the most advantageous position is obtained. As soon as this is done and the required observations have been made, a previously prepared plate is adjusted into position, and a precise and permanent radiogram taken.

Even when no stenosis is present, X-ray examination is of value, as it may show a retention of a small portion of the opaque substance at the site of an early lesion, similar to the shadow sometimes left behind at the site of a gastric ulcer after the main gastric meal has passed on. This is most typically observed in a carcinomatous ulcer developing in a previously dilated œsophagus. If only a slight stenosis is present, no arrest of the fluid is seen, but a slight diminution in calibre of the tube may be indicated. This

frequently calls for a repetition of the examination, or at least indicates the region of the œsophagus to which special attention is to be paid on œsophagoscopy. Below the level of arrest the œsophagus is never well filled, as the substance passes rapidly into the stomach. Even if the exact nature of the cause of the obstruction is not typical enough to allow of a certain diagnosis, the site of the stenosis is located, and renders endoscopic examination easier.

FIG. 74.—Radiogram of a case of hypopharyngeal diverticulum in the oblique position.

I would indicate by means of radiographs the typical appearances of certain forms of œsophageal obstruction. In *Figs.* 71 and 72 is seen the typical picture of barium passing through a malignant stricture, with the irregularity of its lower extremity (rat-tail-like appearance). *Fig.* 73 shows the smooth regular outline seen in a case of cardiospasm. In a third case, the one picture (*Fig.* 74) shows a stricture with the barium appearing to pass from the lower end of the dilated area; but when this patient was rotated and examined in the antero-posterior plane (*Fig.* 75), the barium could be seen emerging from the upper end of the dilatation, giving the typical radioscopic appearance of a Zenker's diverticulum.[1]

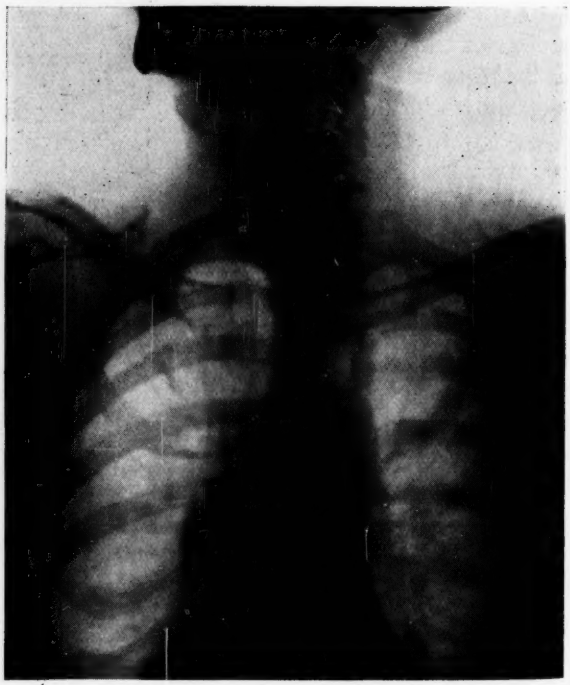

FIG. 75.—Radiogram of the same case taken in the anteroposterior position.

If it is proposed to treat a case by means of radium, it is essential that the total length of the malignant stricture be accurately determined. For this purpose retrograde radiography is employed. This is done by placing the patient in a slight Trendelenburg position on an X-ray table, and the radiograph is taken while he is swallowing a fairly thick mixture from a drinking-cup. Or it may be sufficient to have the patient lying horizontally, with the right shoulder on the table and the negative placed against the posterior part of the left shoulder.

Lastly, the patient must be œsophagoscoped. This is of extreme importance, especially in the earlier stages of the disease, and should always be undertaken in order that an accurate diagnosis may be made. In skilled hands this procedure is almost devoid of danger. I was distressed a short time ago when a well-known French endoscopist said, "I understand that œsophagoscopy is never performed in England, as an English surgeon recently told me that he considered it an invariably fatal operation". I hastened to correct this, and am pleased to be able to say that no patient has died as a result of œsophagoscopy by my hands.

Space does not permit me to go into details of instrumentarium or technique; but I should like to recommend Bensaude's œsophagoscope[2], with the inner tube working on an ingenious ratchet which makes manipulation very easy. This I prefer for all examinations of the œsophagus, while, for local applications and intubations, I prefer the larger make of instrument by Souttar.[3]

Appearances on Œsophagoscopy.—As the examining tube approaches the level of a malignant lesion, the wall of the œsophagus appears relatively immobile and stiffened, and does not move, as it has been noticed to do at a higher level.

The actual appearance of the tumour varies with the type that is present. In the first or proliferative variety the growth has a cauliflower-like appearance (*Fig.* 76). The tumour is seen to be covered with a blood-stained fœtid discharge and bleeds very easily.

In the second or ulcerative type, the hard, raised, irregular, and everted edge is first seen; the ulcer appears somewhat raised, and the surrounding wall appears dense and indurated (*Fig.* 77). A light touch with a swab removes blood-stained fœtid material.

In the third or scirrhous type, the lumen of the œsophagus is seen to be greatly narrowed and deformed, whilst the mucosa appears retracted, red, smooth, and immobile (*Fig.* 78).

A portion of growth, when possible, must be removed for microscopical examination.

Early commencing carcinoma of the œsophagus is not often seen, and the presence of a slightly projecting immobile mucosa, with no obstruction to the passage of the tube, is easily overlooked and must be searched for most carefully. As the œsophagoscope is withdrawn, the observer should specially notice the manner in which the canal appears to close, as local rigidity and non-closure are characteristic of an early malignant lesion.

The examination should preferably be made with the use of a local anæsthetic, because the co-operation of the patient is of the greatest aid. The subjective sensations are not so disagreeable as might be expected, but with a nervous patient a general anæsthetic is used.

If the growth which has been diagnosed in the œsophagus is high enough to make extension to the trachea or bronchi possible, œsophagoscopy should always be supplemented by tracheobronchoscopy before any attempt at radical removal is undertaken, in order to be sure that the air-passages are not invaded by the growth.

Similarly with a growth at the lower end of the œsophagus, gastroscopy should be performed. I have recently had three cases in hospital at the same time, in each of whom an early growth was diagnosed at the lower end of the gullet. An ordinary opaque meal failed to show any abnormality of the

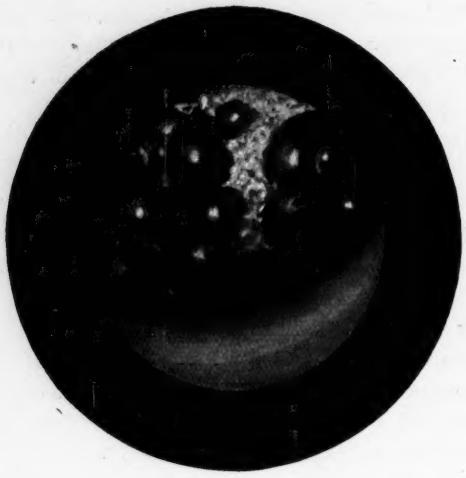

FIG. 76.—Endoscopic appearance of the proliferative type of carcinoma of the œsophagus.

FIG. 77. — Endoscopic appearance of ulcerative type of carcinoma of the œsophagus.

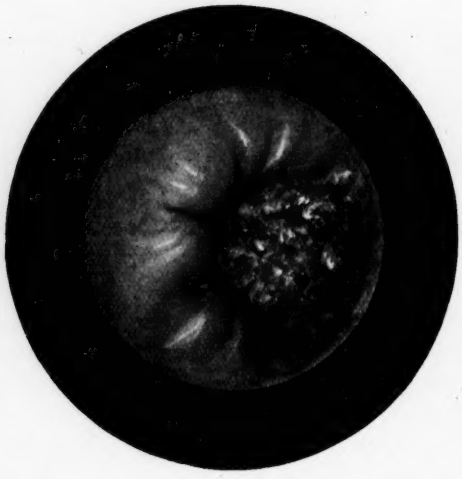

FIG. 78.—Endoscopic appearance of scirrhous type of carcinoma of the œsophagus with commencing proliferation.

stomach; but laparotomy with a view to attempting a radical cure revealed an extensive growth of the fundus which could have been diagnosed correctly had gastroscopy been performed.

PATHOLOGY.

Certain pathological factors must be borne in mind when any particular case is being considered, as every case of cancer should be considered, with a view to effecting a radical cure.

Primary carcinoma of the œsophagus may occur at any level, but is usually found at either extremity or in the narrowed portion where the œsophageal lumen is diminished by pressure of the left bronchus. The middle portion of the œsophagus is most commonly affected, the lower portion being next in order of frequency, and lastly the upper end, these being roughly in the proportions of 3 : 2 : 1.

The pathological types have already been shown in the pictures of the œsophagoscopic appearances. The important matter from our point of view is the manner in which cancer of the œsophagus spreads. The two main routes are : (1) *By direct extension* ; (2) *By the lymphatic stream.*

1. **Direct Extension.**—The growth at first, starting in the mucosa, spreads more or less concentrically, though, in the upper two-thirds of the organ, with a slight preference for the vertical direction. Infiltration then occurs into the submucous and muscle layers. *At a much later date* a stage of ulceration and of invasion of neighbouring organs is reached.

2. **Lymphatic Spread.**—There is but a slow tendency for œsophageal carcinoma to affect the lymphatics or to form metastases, compared with the rapidity with which the growth kills the patient. This usually prevents the lapse of sufficient time for spread by the lymphatic system to be markedly established.

At first the enlarged glands do not necessarily contain any carcinomatous cells, but may be purely inflammatory in nature, due to the infective processes taking place on the surface of a carcinomatous ulcer. Sooner or later, however, carcinomatous infection of the lymphatic glands is apt to occur, and an important point when the radical operability of carcinoma of the œsophagus is being considered is the time when the malignant invasion of the glands makes its appearance. In addition to the question, therefore, as to whether a carcinomatous growth has invaded neighbouring organs, or whether its local peri-œsophagitis has rendered it adherent in the mediastinum, are the questions : Are any local lymphatic glands involved ? Are any more remote lymphatic glands involved ? Has general metastasia taken place ?

In order to answer these questions, in the absence of physical signs, the only method is that of recording and analysing a large number of post-mortem findings in patients who have died of the disease. From this a very fair estimate may be made ; but it must be remembered, in dealing with the living subject, that his condition is not so far advanced as it will be on the day of his death, and therefore the outlook is brighter for the living than it would appear to be from examination of the dead.

Helsley,[4] in his analysis of 70 cases carefully examined post mortem with regard to glandular involvement and metastases, found that in 64 per cent the carcinomatous condition was confined to the œsophagus, and no secondary deposits were present in the lymphatic glands or other organs. The local lymph nodes alone were involved in 6 per cent, whilst in the

remaining 30 per cent more distant lymph glands and other viscera were affected.

In a recent communication by Blauwkuip,[5] he records the post-mortem findings with reference to this matter in 125 cases. Of these, in 39 per cent the disease was localized to the œsophagus, in 47 per cent no glandular involvement by the malignant process had taken place, while 64 per cent showed no metastases in remote organs.

The average duration of symptoms in Helsley's cases was almost five months, and it is therefore obvious that carcinoma of the œsophagus is at first, and for some considerable time, a purely local disease, and that there is ample time for the diagnosis and treatment of a case before metastases occur.

Even if extension to neighbouring organs, or perforation, has taken place, this may be seen when a radical operation is attempted, and judging from these figures, will be found to have occurred in not more than one case out of two. Even if this type of case has produced glandular metastases at the same rate as all classes of cases taken together, at least 50 per cent of these will not be accompanied by involvement of the lymphatic glands. Helsley goes so far as to state that " irrespective of the duration of the disease, the possibility of metastatic formation without evidence of the same should not be considered as a contra-indication to radical operation ".

Most authors are in agreement that metastases do not tend to occur early, giving the freedom from metastases in from 46 per cent to 72 per cent of cases. It would thus appear from pathological findings at post-mortem that at least one case in four is operable to radical methods even up to the time of death. As many cases are seen several weeks or months before death, it would appear probable that at least one in three, or possibly one in two, of all cases seen should be curable by radical surgical operation.

PALLIATIVE TREATMENT.

With regard to palliative treatment, only the briefest outline will be given of the modern methods of treatment of cancer of the œsophagus in cases in which the presence of metastases indicates that an attempt at radical operation is futile, or in subjects so enfeebled that a major operation could not be borne.

Gastrostomy.—The majority of cases in this country are treated by gastrostomy alone so far as one is able to judge. This must be regarded as little short of masterly inactivity, and it is high time that we bestirred ourselves and expended much further effort to improve our technique with a view to active attack upon the disease of these unfortunate sufferers.

Dilatation.—A further step is repeated dilatations of the stricture. This must first be performed under endoscopic vision, and may then be followed every week or two by the blind passage of graduated sounds. Each treatment is followed by a general improvement in the patient's symptoms, and although not an ideal treatment and not devoid of risk, is to be recommended when more modern methods are not available.

Intubation.—This may be done with considerable benefit to the patient, and with more lasting effect than dilatation. I prefer the use of a gum-elastic tube such as Symonds'[6] or a small de Pezzer's tube such as Guisez's.[7] I have now used Souttar's tube[8] in six patients. In three of these it passed into the stomach in a few days, and in the remaining three it formed an œsophago-tracheal fistula, with resulting death of the patient within a fortnight.

Radium.—The most active palliative method of treatment is by application of radium. The efficacy of this substance in the treatment of malignant disease has long proved a bone of contention between surgeons on the one hand and radiologists on the other; and an unbiased opinion of its true value is difficult to obtain. There seems little doubt that, in the treatment of malignant disease generally, radium causes a regression of the growth at the site of application, whilst sloughing is increased, hæmorrhage is brought on more quickly, and the periphery of the growth, or the infected glands at a distance, are stimulated to increased activity. The œsophagus, however, is unique in its position as an anatomical structure, and some of the contra-indications against radium may be waived; and, whilst it is not without a certain degree of danger, it frequently causes a great improvement in the patient's condition.

Radium is best applied through an œsophageal catheter. The upper limit of the growth having been carefully measured from the incisor teeth at the time of œsophagoscopy, and the length of the growth having been determined by retrograde radiography as already described, the catheter containing the radium is introduced so that the latter accurately fills the whole of the tumour-bearing area of the œsophagus (Guisez).[9]

The dosage recommended is 100 to 120 mgrm. of radium bromide, which should be applied on alternate days for some six to eight hours at a time, for a period of about two weeks. A remission of symptoms may now occur; but after a short time a cicatricial contraction supervenes, and this demands careful dilatation.

Guisez has 3 cases out of a total of 1430, of which 270 were treated by radium, which have survived for five years or more with this treatment.[10] As far as is known, every other worker with radium shows a 100 per cent mortality.

Diathermy.—Judging from the results obtained in cases of malignant disease of the mouth and pharynx, diathermy should have an effect equal to, if not better than, the application of radium. I have had the opportunity of using this method of treatment in a few cases. Almost the whole of a projecting mass of growth can be caused to disappear, and the permeability of the œsophagus may sometimes be restored. Patients who are submitted to diathermy should show no signs of involvement of the lungs or air-passages either by the growth or by infective processes. Repeated small hæmorrhages point to an extensive ulceration, and may at any time be followed by a large, or even fatal, hæmorrhage, and are to be looked upon as a contra-indication. In suitably chosen cases diathermy is of marked value; but a fulminating mediastinitis or secondary hæmorrhage is apt to make its appearance with fatal results.

RADICAL TREATMENT.

The problem of the cure of cancer as submitted to the surgeon calls for a radical removal of the disease. The first question in the discussion of any particular case of cancer is as to whether the condition is operable or otherwise. If, as far as human judgement can tell, in any particular case it is considered that a radical removal of the whole growth can be effected, this is always attempted where anatomical factors do not render it absolutely impossible. In this connection might be mentioned a primary carcinoma of the liver or a large gliosarcoma of the brain, in which a radical removal would undoubtedly be followed by death. On the other hand, the removal of a lung was looked upon as an impossibility until a few years ago, but has now been accomplished with success. Malignant disease of the rectum was in a similar position, with the possible exception of a few cases of early growth at its lower end, until abdominoperineal excision was introduced. It is being realized more and more generally every day that early and complete removal of a malignant tumour is the only hope in attempting a cure.

Is the œsophagus to be placed in the category so recently inclusive of the rectum and lung in that every case is, *a priori*, inoperable? Dr. William Hill[11] says, "The operation . . . is so fatal as not to be worth attempting". I entirely disagree, and would rather say, "the *disease* is so fatal that, in the absence of any contra-indication such as metastases or extreme emaciation, radical removal should always be attempted". When the enormous strides of major surgery in the last decade are considered, there would appear to be ample reason for continuing the battle against apparently overwhelming odds, and for leaving no stone unturned in the experimental laboratory with a view to exploring every conceivable method of dealing with the problem, and, further, endeavouring to apply these methods to human beings.

The fact remains that a proportion, and a fairly large proportion—according to some observers 70 per cent—of cases are surgically operable at the time when they are first seen by the medical practitioner, and some 30 to 50 per cent are operable when seen by the surgeon.

RADICAL OPERATION IN THE CERVICAL REGION.

I should like to say that I owe most of my knowledge of this subject to the time I spent as dresser and house surgeon to Mr. Wilfred Trotter, to whom I am also very grateful for suggestions and help in my experimental work in connection with the radical removal of the thoracic œsophagus.

It is now over twenty years since Mr. Trotter first utilized a skin flap for the reconstruction of a pharynx[12] part of which had been removed for malignant disease, which method he has also used for the cervical œsophagus, and has suggested for dealing with the thoracic œsophagus.

The chief dangers of operations upon the cervical œsophagus are: (1) *Shock*, which is an inconspicuous factor, and easily combated; (2) *Hœmorrhage*, which, although it demands attention, is not difficult to deal with; (3) *Infection*, or so-called sepsis.

Infection.—The pharynx and œsophagus form a very special region in surgery with regard to septic infection, due both to the presence of the teeth

and to the absence of any covering analogous to peritoneum. The healthiest set of teeth are no guarantee against the organisms which cause acute ulceration of the mouth, destructive ulceration of the fauces, or an ulcerative angina. There is, indeed, a distinct difference between infection occurring in patients with clean teeth, compared with those who have obvious caries or pyorrhœa; but it may definitely be laid down that acute sloughing inflammations are likely to arise unless the patient has been edentulous for some time. This particular variety of sloughing persists without suppuration for four or five days, and with only a slight rise of temperature, during which time a brownish slough covers the infected area. After this time the sloughs begin to separate, and suppuration occurs. If free drainage has been supplied, or the condition is recognized and the part opened freely, pus is discharged for about seven days; then granulations begin to form. It occasionally happens, however, in certain circumstances, that the infection spreads uncontrollably—not only in the neck, but it may extend to the thorax.

Secondary hæmorrhage frequently occurs in a manner of great interest, because of the dramatic, tragic, and disappointing way in which it appears; the patient may have no temperature and may appear to be progressing favourably up to any day between the fifth and tenth, when severe hæmorrhage occurs, and the blood may pass into the pharynx and give rise to asphyxia.

Methods of Preventing Septic Complications.—

1. *Condition of the Mouth.*—If the patient is edentulous and the mouth comparatively aseptic, sloughing inflammation very rarely occurs. If the patient is not edentulous, the prospect of having all the teeth removed is so formidable that the operation may be refused altogether. The rule, therefore, is that any obvious sepsis should be carefully attended to; whilst, if extensive extraction is essential and agreed to, four weeks must be allowed to elapse in order that the sockets may heal.

2. *Treatment of the Wound.*—All wounds of the cervical œsophagus must be carefully stitched up, and leave no raw surface, either (*a*) by bringing the divided parts together, or (*b*) by turning in a flap of skin from the surface. This is done for two reasons: first, to diminish the size of the wound and to hasten convalescence; and, secondly, to protect the wound as far as possible, and to help granulations to occur.

3. *Drainage.*—If complete closure of the wound is not obtained, the freest drainage must be secured. Even if closure of the œsophagus is obtained, the area should be freely drained.

4. *The Care of the Lungs.*—The danger of aspiration of blood or infected material into the lungs during the operation must be abolished. This is best attained by means of either an intratracheal anæsthetic or a preliminary laryngotomy or tracheotomy.[13] In either case the pharynx must be completely plugged in the region of the epiglottis in order that no foreign material may find its way into the larynx and trachea. If an intratracheal anæsthetic is not obtainable, I use my laryngotome to perform a laryngotomy.

Technique of Operation.—The operation consists of three stages: (1) Exposure; (2) Excision; (3) Reconstruction.

1. *Exposure.*—All plastic operations upon the cervical œsophagus demand the provision of a skin-flap (*Fig.* 79) in order that this may be used to restore

the œsophageal continuity; otherwise the patient will develop a stricture. It is usually advisable to attack the growth from the right side of the neck, in order that manipulation may not be hampered by the thoracic duct. The exact position of the growth having been ascertained previously, and an estimate having been gained of the breadth of the flap required to restore the continuity of the gullet, a flap is made with its base either at the right or left side of the neck and extending well beyond the mid-line. The next step, after hæmostasis has been secured, is to divide the deep fascia along the anterior border of the sternomastoid, and also to divide this muscle at its origin from the sternum and clavicle. The carotid sheath is now mobilized, after ligature of the inferior thyroid artery, and the prevertebral fascia and muscles discovered to its inner side. The anterior border of the sternomastoid is then sutured to the prevertebral region. The affected portion of the œsophagus is seen lying behind the trachea, with the prevertebral muscles and the sternomastoid behind and to the outer side. Very little blunt dissection is now required to separate the œsophagus from adjacent structures, and the region of the growth may be carefully examined and the possibility or otherwise of radical cure determined. If the case prove favourable, the trachea together with the thyroid gland and the recurrent laryngeal nerve are retracted, and the whole region surrounding the area of proposed excision is carefully packed off with sterilized gauze, which may with advantage be moistened with a solution of 1–500 perchloride of mercury. The next stage is to open the lumen of the œsophagus and thus expose the tumour to view. The surface of this must now be cauterized and carefully examined.

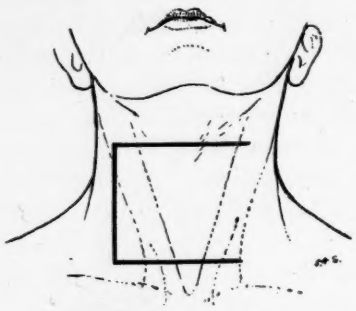

FIG. 79.—Diagram of position of skin-flap used in operations upon the cervical œsophagus.

2. *Excision.*—With a small and early growth the incision around it must include three-quarters of an inch of apparently healthy œsophageal wall. In a larger growth this will mean the removal of a complete portion of the œsophagus with complete dissolution of its continuity.

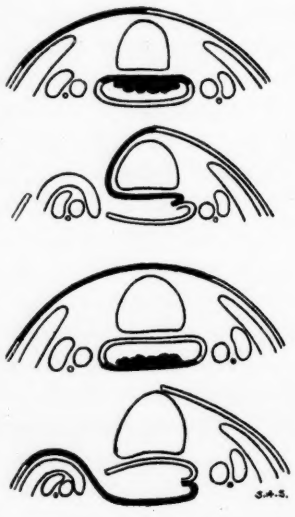

FIG. 80. — Diagram of formation of skin-flap in repair of cervical œsophagus after partial excision for carcinoma.

3. *Reconstruction* (*Fig.* 80).—The flap of the skin is now turned inwards and made to lie in the position vacated by the piece of œsophagus removed. By means of mattress sutures the skin is then united to the mucous membrane, the epidermal surface forming the interior of this plastic portion of the œsophagus. The apex of the flap is now sutured to the portion of skin from which it was originally divided, thus leaving a depressed and funnel-shaped opening which passes into the

œsophagus. Through this opening a tube must be passed into the lumen of the œsophagus, and the patient must be attended constantly for at least one hour, but preferably longer, in order to make sure that the tube is neither vomited nor withdrawn by him. From the upper and lower edges of the field of operation pieces of gauze are left projecting, together with one or more drainage tubes; the function of the latter is to provide free egress for any leakage from the œsophagus, and therefore to diminish the possibility of the development of cellulitis; whilst the function of the former is to hasten the development of granulation tissue. After the first hour or two of consciousness after recovery from the anæsthetic the intra-œsophageal tube can easily be tolerated by the patient.

The Treatment of the Lymphatic Glands.—At the time that the original skin-flap is raised both sides of the neck come within the surgeon's reach, and the paratracheal, para-œsophageal, and inferior deep cervical glands are exposed, and may be removed. This must, of course, be done on both sides of the neck.

It is sometimes thought advisable to pass a tube from the lateral aspect of the neck not only downwards into the œsophagus but upwards into the pharynx. Some authorities, however, pass a tube through the mouth, the pharynx, and the newly-formed plastic part of the œsophagus into the œsophagus proper. Once the patient has recovered from the anæsthetic, this is usually well tolerated.

SURGICAL APPROACH TO THE THORACIC ŒSOPHAGUS (POSTERIOR MEDIASTINOTOMY).

We now pass to the treatment of those cancers of the œsophagus which are situated in the middle two-fourths of the gullet. In order to reach these, posterior mediastinotomy must be performed.

Preliminary Considerations.—A few words are necessary here with reference to thoracic surgery in general. The patient must be examined with a view to ascertaining that he is fit to stand a serious operation. If he is emaciated and the tissues are suffering from marked dehydration, a gastrostomy or jejunostomy must be performed from seven to fourteen days before the major operation.

Gastrostomy: Jejunostomy.—If the growth is known not to involve the stomach, gastrostomy is performed. If the stomach is likely to be involved in the major operation, jejunostomy must be performed. As the performance of such a fistula is frequently carried out in an unsatisfactory manner, I feel justified in describing what I have repeatedly found to be the method which gives uniformly satisfactory results. These remarks are applicable to either gastrostomy or jejunostomy.

It frequently happens that in a case in which gastrostomy is indicated a general anæsthetic is strongly contra-indicated, either because of definite evidence of lung disease, or of obstruction to the upper respiratory tract, or on account of the extremely wasted condition of the patient. Certainly under these circumstances, and even when no such condition is present, gastrostomy may be performed under the influence of a local anæsthetic.

This may be administered: (1) by local infiltration, (2) by regional nerve block.

A vertical incision is made along the line of the intradermal infiltration, and each layer divided in the same line. If the incision has been close enough to the costal margin the stomach will be found with no difficulty, though it is frequently very contracted and may lie almost entirely under cover of the costal margin. The stomach having been found, it is drawn into the wound, held in place by suitable forceps, and surrounded by damp cloths or a rubber-dam.

It now remains to make an opening into the stomach which will not allow

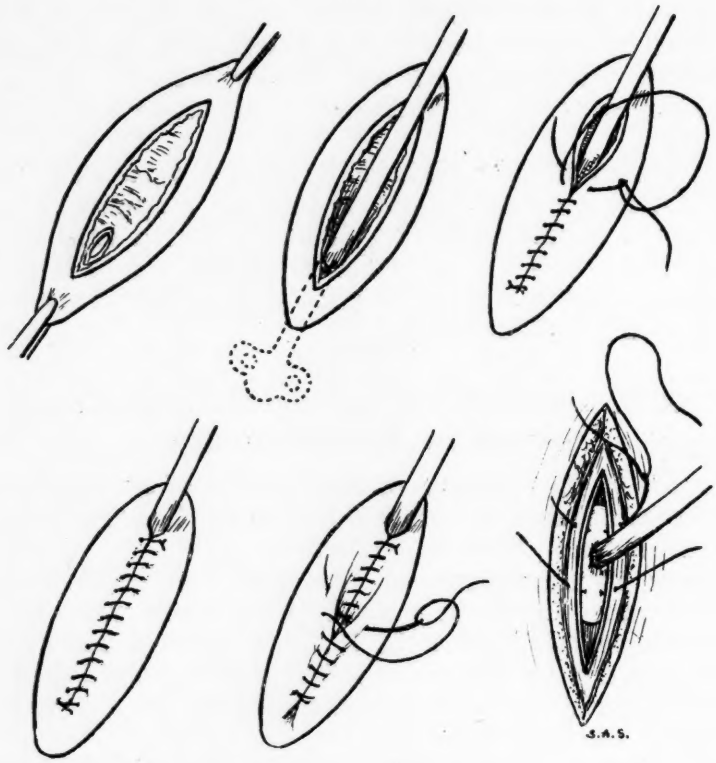

FIG. 81.—Diagram showing a modification of Witzel's gastrostomy.

an escape of gastric contents. This is best performed by passing the gastrostomy tube obliquely through the wall of the stomach. In order to attain this I use a modification of Witzel's method:[14] an incision is made through the serous and muscular layers of the stomach in a longitudinal direction without injury to the submucous or mucous coats. A little blunt dissection separates these layers from the submucous layer on either side of the incision for a quarter of an inch. A stab incision is now made through the mucous membrane at the pyloric end of the incision and the gastrostomy tube passed into the stomach through this, and held in position by one or two catgut sutures. The tube is then laid along the prepared groove, and the serous and

muscular walls are sutured together in front of it by means of a continuous suture. Now, commencing half-an-inch beyond the pyloric end of the original incision into the stomach, a continuous Czerny-Lembert suture is employed still further to invaginate the tube and its seromuscular covering. The stomach is then sewn to the parietal peritoneum and the posterior sheath of the rectus by two or three sutures, and the abdomen closed layer by layer, leaving the tube projecting. I prefer the use of a large-sized self-retaining catheter or, better still, a large-sized de Pezzer tube. (*Fig.* 81.)

Blood-pressure.—Having successfully combated the patient's dehydrated state, the next point which requires attention is the condition of the blood-pressure. If this is less than 125 mm. Hg (systolic), treatment must be instituted until it reaches this pressure. The percentage of hæmoglobin should not be less than 60. If it is, a blood transfusion should be performed, using 500 c.c. of blood from a suitable donor forty-eight hours before the major operation. The coagulation time of the blood should be tested, and, if this is found to be less than seven minutes, an intramuscular injection of 30 to 40 c.c. of a sterile water solution of sodium citrate should be given at the commencement of the operation. The bowels should be moved forty-eight hours before, but no nearer to, the operation. Special attention must be paid to the sterilization of the skin, remembering that a small furuncle may infect a whole wound.

Lilienthal[15] gives the following precautions when operating: (1) During the operation a blood-pressure apparatus should be kept adjusted and frequent readings taken. This will give warning of impending collapse before any other signs are evident. (2) Therefore plan the operation so that it can be stopped if the patient collapses, and continued at another sitting, the first stage having for its object the formation of adhesions, which diminish the complications due to the interference with the normal thoracic mechanism and thereby greatly reduce operative danger. (3) Make sure of the position of the growth, and that you are operating on the correct side. (4) Place the patient in the best position at the beginning of the operation.

Anæsthesia in Thoracic Surgery.—Major procedures within the thorax rank highest in that operative success depends upon the skill of the anæsthetist and the efficacy of the method of anæsthesia employed. I need not dwell long on this subject; it is sufficient to say that narcosis should be maintained by means of a nitrous-oxide-oxygen combination, using only a little ether at the time of induction until the intratracheal or endopharyngeal tube has been satisfactorily adjusted. By either intratracheal or intrapharyngeal insufflation a positive pressure may be maintained in the lungs, so that if the pleura is accidentally opened—as is often the case in exploration of the œsophagus—none of the ill-effects of an acute pneumothorax make their appearance.

The Pleura.—One must bear in mind that it is extremely easy to infect the pleura, and that therefore operations designed to effect partial or total œsophagectomy which do not entail opening the lumen of the gullet *in situ* are more apt to be successful than those where immediate section of the organ is performed.

Even with prolonged exposure alone a considerable quantity of serous

exudate is produced by the pleura during the first twenty-four to forty-eight hours after the operation. The lungs must therefore be fully inflated before the last stitch is tightened in order that adhesions may form rapidly, and if the time of the operation has been long a water-seal drainage should be used. *Fig.* 82 shows the arrangement of this after Kenyon's method,[16] together with a bottle to catch the discharge. The drainage tube must fit tightly into the thoracic wound, and must not project more than an inch into the pleural cavity.

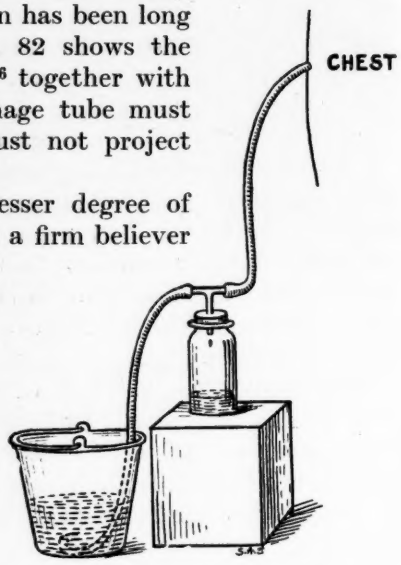

FIG. 82.—Kenyon's method of water-seal drainage.

Post-operative Shock.—As a greater or lesser degree of post-operative shock is bound to occur, I am a firm believer in taking steps to combat or prevent this before it makes its appearance. Already the patient has been rendered as fit as possible for the operation. When this is over, blood transfusion is perhaps our greatest aid, and may be performed even if it was done before the operation.

A simpler method, and one which I have used in a large number of major operation cases, including mediastinotomy, is to give an intravenous injection of 15 per cent glucose in either normal saline or sterile water together with 20 to 30 units of insulin intramuscularly. At the same time a subcutaneous injection of oxygen is given into the upper and outer aspect of the thigh, using from 500 to 1000 c.c. (McDonagh[17]).

Hot rectal injections of saline with large proportions of glucose and bicarbonate of soda are of great value, as is also hypodermoclysis. Morphia has also a distinct place in this treatment.

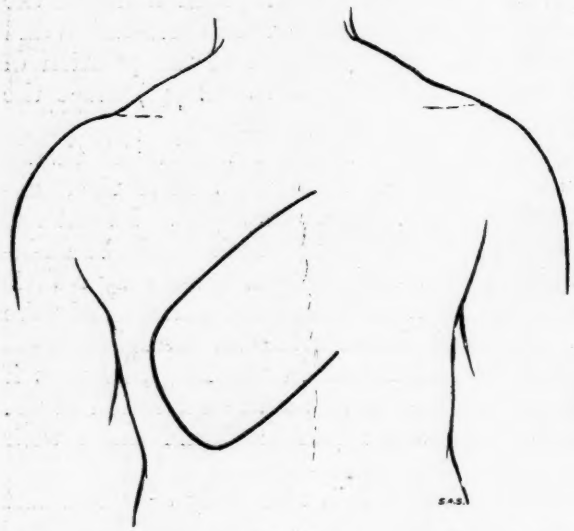

FIG. 83.—Diagram showing position of incision for skin-flap for reconstruction of thoracic œsophagus.

Technique of Posterior Mediastinotomy.—When this operation is undertaken for the relief of cancer of the thoracic œsophagus situated above the lower two or three inches of the gullet, the incision must always be planned with a skin-flap of sufficient size to enable this to be passed around the tumour-bearing area of the organ.

If the growth is situated at or above the level of the aortic arch the incision is made in the right side of the back of the thorax. If below this

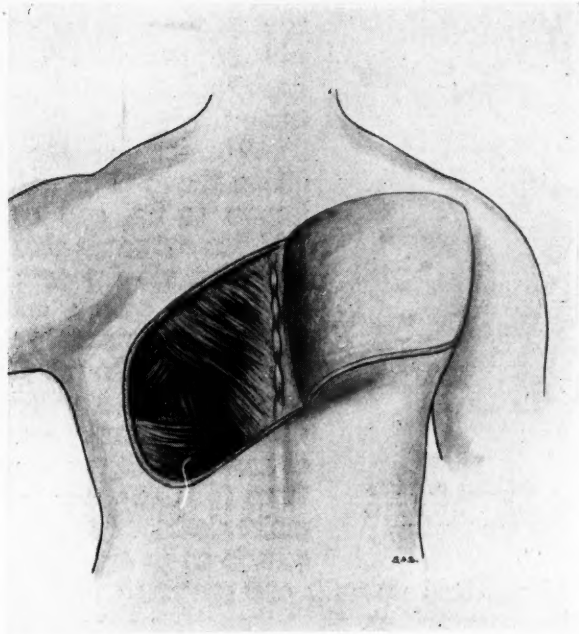

FIG. 84.—Diagram showing muscles exposed when skin-flap is dissected up.

FIG. 85.—Posterior mediastinotomy; three inches of one rib have been removed, and three other ribs have been divided close to their junction with the spine. (From an actual operation.)

FIG. 86.—Posterior mediastinotomy; the shingled ribs are retracted and the pleura is being carefully stripped away from the mediastinum. The hands are drawn small in proportion. (From an actual operation.) (*After Lilienthal.*)

level, it is made on the left. Operations for the cure of cancer in the lower two to three inches of the œsophagus will be described later. I will now describe a left-sided partial œsophagectomy in detail.

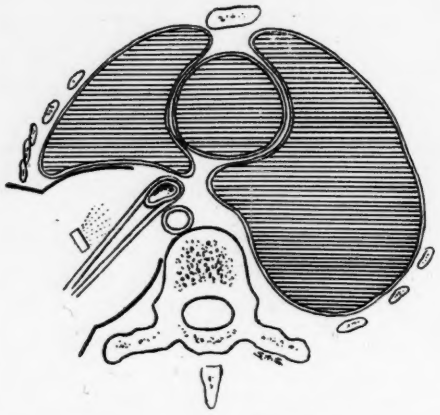

FIG. 87.—Diagram showing relationship of structures with œsophagus isolated by posterior mediastinotomy.

The incision (*Fig.* 83) starts 2 in. above the level at which the growth is known to be, and extends from the mid-line outwards along the line of the subjacent rib for some 5 to 7 in. It then turns with a rounded-off corner vertically downwards for 5 to 6 in.; then towards the mid-line again parallel to the first incision. This flap including skin and subcutaneous fascia is now dissected up from the underlying structures (*Fig.* 84), and wrapped in warm moist cloths. As much of the trapezius muscle as is exposed is then detached from its origin and reflected upwards and protected with cloths. The latissimus dorsi is either retracted, or, if much of it is exposed, it is dealt with in like manner.

The posterior aspects of five or six ribs are thus exposed, covered towards the mid-line by the vertically placed tendons and fibres of the erector spinæ. This I now divide between clamps in a transverse direction at the upper and lower extremities of the wound, thus making a muscular flap which is turned towards the opposite side of the body and lies with the original skin-flap.

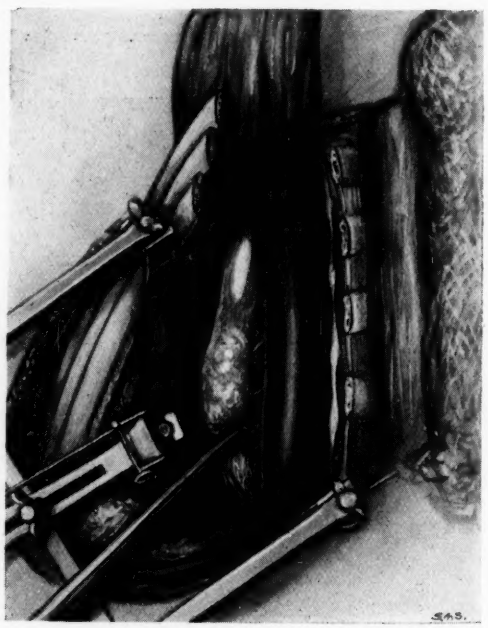

FIG. 88.—Posterior mediastinotomy; the pleura has been stripped from the mediastinum, and the aorta and the cancer-bearing area of the œsophagus are exposed. A light on the middle blade of the retractor illuminates the field of operation, and an electric diaphane transilluminates the œsophagus. (From an actual operation.)

Three or four inches of the lowest rib exposed are now resected subperiosteally, the inner section of rib being as near the transverse process as possible (*Fig.* 85). The underlying pleura is exposed but not opened, and extreme care and gentleness are now required to press the pleura away from the under surface of the rib above. When this has been done I inject the intercostal nerve with absolute alcohol for anoci-association purposes, and then section the rib as near the transverse

process as possible. This may now be retracted upwards and outwards by the assistant. The pleura is pressed away still further, and in all three or four ribs may be dealt with in this way. This is known as shingling the ribs. The accompanying diagram shows the result obtained (*Fig.* 86). The intercostal arteries must each be tied at both ends as each rib and artery is severed.

As a rib-retractor I have used Thomson-Walker's three-way bladder-retractor.[18] This is powerful enough for the purpose, and at the same time allows a light to be fitted on to the middle blade which illuminates the interior of the thorax and makes identification of the structures very easy (*Fig.* 87).

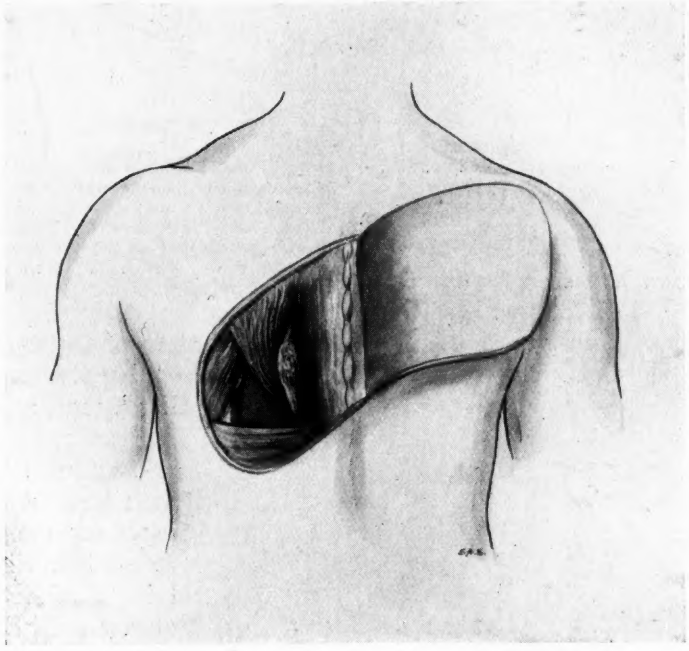

FIG. 89.—The œsophagus is lying in the newly-formed muscular bed.

In order that the blades may not damage the pleura, I protect this by cloths wrung out in a ½ per cent solution of novocain. This helps to diminish the powerful pleural reflexes, and is especially useful if the pleura has been opened. The pleura lining the lateral aspects of the bodies of the vertebræ is carefully stripped from them, and the aorta readily comes into view. Before this is reached a little care must be taken not to remove the sympathetic and splanchnic nerves with the retracted pleura. This is a matter of no difficulty. A little further stripping now reveals the œsophagus. In order that its identification may be rendered easy, a sound may be passed into it, or, better still, Lilienthal's electric diaphane used.[19] This is simply a small electric bulb attached to a rubber sound which transilluminates the œsophagus.

If preliminary investigations have been carried out accurately, the tumour is readily found, and its operability—or otherwise—may now be ascertained

(*Fig.* 88). If it is operable, matters should then proceed as follows: Two or three of the retracted ribs should be divided some 3 in. from the site of the primary division, thus making three or four ribs in all, portions of which

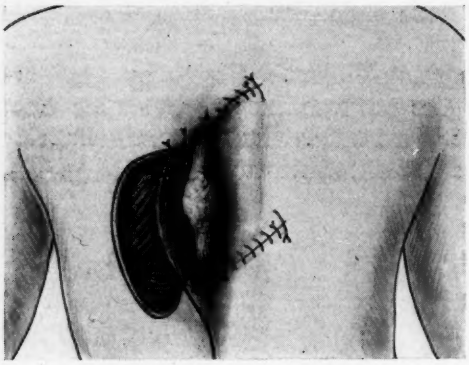

FIG. 90.—The plastic skin-flap is shown lying deep to the œsophagus.

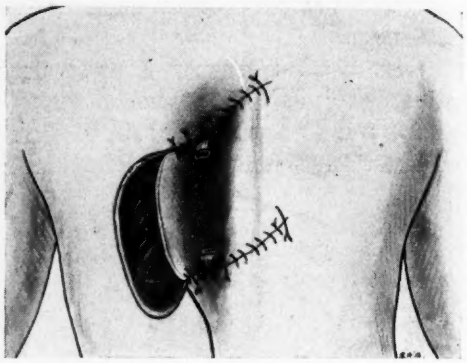

FIG. 91.—The cancer-bearing area of the œsophagus has been removed, and the flap may now be utilized to form the new œsophagus. The black line below in this and the preceding diagram shows the incision required for drawing up skin to fill the raw muscular space.

have been removed. The fibres of the vagi which are seen forming the plexus gulæ are divided with scissors, and the proximal ends swabbed with a small quantity of 2 per cent cocaine. The œsophagus is now separated from the loose cellular tissues in which it lies by means of blunt dissection, or by means of an aneurysm needle curved at right angles which is carefully manipulated all round it until the gullet is lying free for some inches above and below the level of the growth.

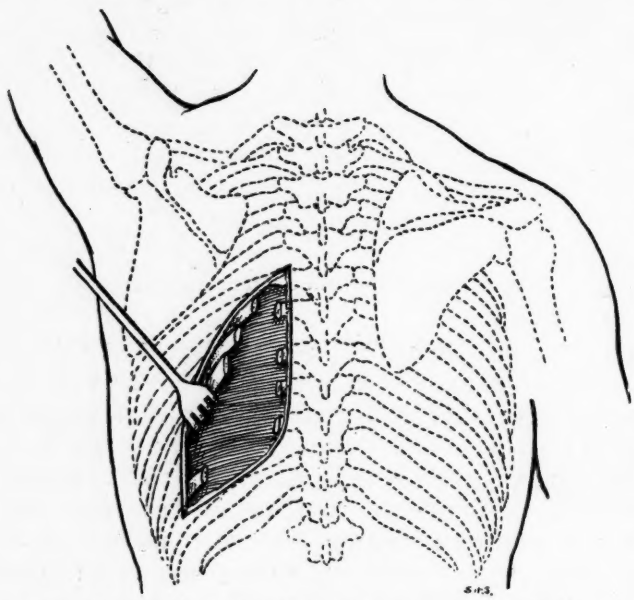

FIG. 92.—Torek's incision for the low posterior mediastinotomy or Lilienthal's operation. (*After Lilienthal.*)

In my animal experiments I pass the free portions of the trapezius above, the latissimus dorsi below, and the erector spinæ to the inner side, deep to the œsophagus, and suture these together with two or three interrupted catgut sutures so that the tumour-bearing area of the gullet is lying in the bed so formed (*Fig.* 89).

In a similar way the skin-flap is also placed anterior to—that is, deep to—the œsophagus, and sutured as nearly as possible to the skin of the back

from which it was originally divided, thus closing off the mediastinum from the skin of the back completely, or perhaps with a small gap at the outer part of the wound (*Fig.* 90). This I now close by means of a small flap turned up from below, and have always succeeded in bringing skin-edge to skin-edge except where the œsophagus passes through.

As already stated, the lungs are carefully distended by increasing the pressure in the anæsthetic tube before the last stitch is drawn tight. If considered necessary, a water-seal drainage is also inserted into the thorax before the wound is finally closed. We now have the growth and an adjacent $1\frac{1}{2}$ to 2 in. of œsophagus on either side of it lying at the bottom of a groove in the back. If tension has not been too great, swallowing may be performed as well as before the operation, and if a gastrostomy was not necessary before the operation, it is not necessary now.

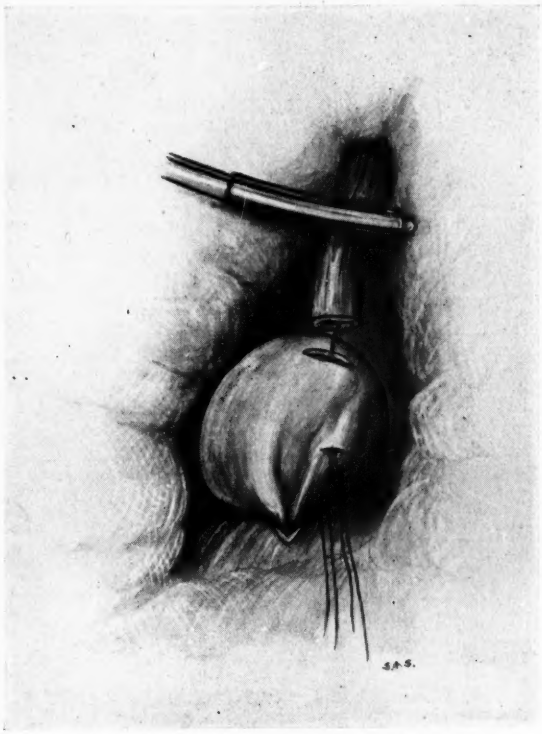

FIG. 93.—Lilienthal's operation. The lower two or three inches of the œsophagus have been removed and an opening made into the stomach. A needle bearing two long threads is passed from below through the main gastric opening to reach the œsophagus. (*After Lilienthal.*)

I have performed this operation upon eight animals with success, and have found no gangrene or rupture of the œsophagus to occur. I have performed posterior mediastinotomy upon two men with a view to radical removal of a growth of the œsophagus, but was unable to carry out the last stage on account of fixity of the growth. One made an uninterrupted recovery from the operation, the other had a large peri-œsophageal abscess and succumbed to mediastinitis in fifteen hours.

Some seven to ten days later the cancer-bearing area of the œsophagus is removed with as much normal tissue as feasible on either side of it (*Fig.* 91). This I would suggest should be at least 1 in. in extent, and more if possible. The sutures are removed from the skin-flap, and it is separated from its base after infiltration with novocain. The inner and outer edges are dissected up and united to each other, while the upper and lower ends of the cylinder of skin thus formed are united to the upper and lower ends of the œsophagus respectively.

Lastly, the remaining inner and outer edges of the skin wound are undermined and drawn together, thus rendering the newly-formed œsophagus subcutaneous. Drainage tubes should be left in place for two to three days in case any leakage occurs.

Operations for Radical Removal of the Lower Two to Three Inches of the Œsophagus.—If gastroscopy has shown that the adjacent portion of the stomach is not affected, the operation is best performed by means of a low left-sided posterior mediastinotomy; in this case a flap need not be raised, but the incision is made commencing some 2 in. from the mid-line opposite the middle of the vertebral border of the scapula, extending vertically downwards to the 10th intercostal space, and then laterally along the line of this intercostal space for from 5 to 6 in. The underlying muscles are retracted in the manner already described, and 3 to 4 in. of the 10th rib removed. The 9th, 8th, and 7th ribs are now shingled as before (*Fig.* 92). The pleura and lungs are carefully retracted, and the lower few inches of the œsophagus and the upper surface of the diaphragm including the œsophageal opening are exposed. By means of blunt dissection the œsophagus is separated from the diaphragmatic opening, which is now incised towards the left and enlarged sufficiently to allow the cardiac region and fundus of the stomach to be drawn into the field of operation. At least 1 in. above and below the growth, the œsophagus is divided by means of the actual cautery, between clamps, the whole area being carefully protected by means of cloths. The opening thus made into the stomach is now closed and invaginated. Then the fundus of the stomach is drawn upwards so that it easily reaches 1 in. above the lower end of the remaining portion of the œsophagus, and an incision large enough to admit the œsophagus is made into it. About 1½ in. below this incision a smaller incision is made into the stomach. Through the latter a needle bearing two long pieces of suture is passed, emerging again through the larger and upper opening (*Fig.* 93). The sutures are drawn through the larger opening and cut, so that four sutures are now available. Each of these is re-threaded on to a needle and passed through the wall of the œsophagus at four equidistant points (*Fig.* 94). Traction is now made upon these sutures and the œsophagus is drawn into—that is, intussuscepted into—the stomach, where it is retained by means of two or three sutures which pass through the wall of the stomach and œsophagus

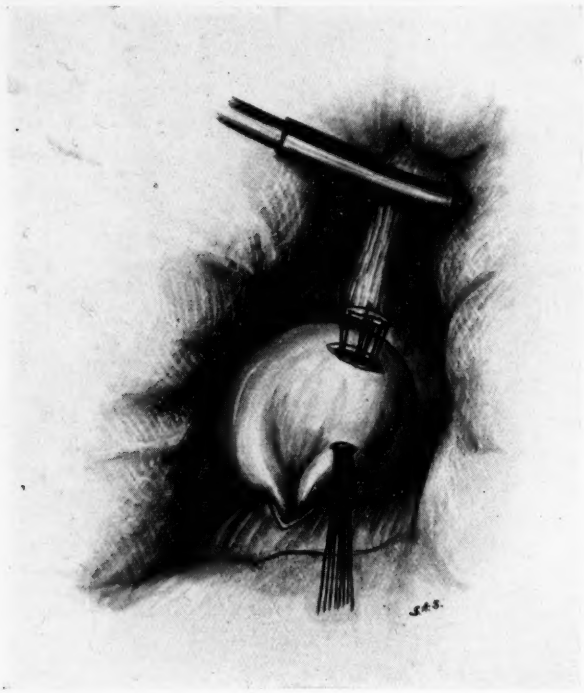

FIG. 94.—Each of the two threads is cut, and the four threads thus obtained inserted through the œsophagus at equidistant points. These threads are now utilized to intussuscept the œsophagus into the stomach. (*After Lilienthal.*)

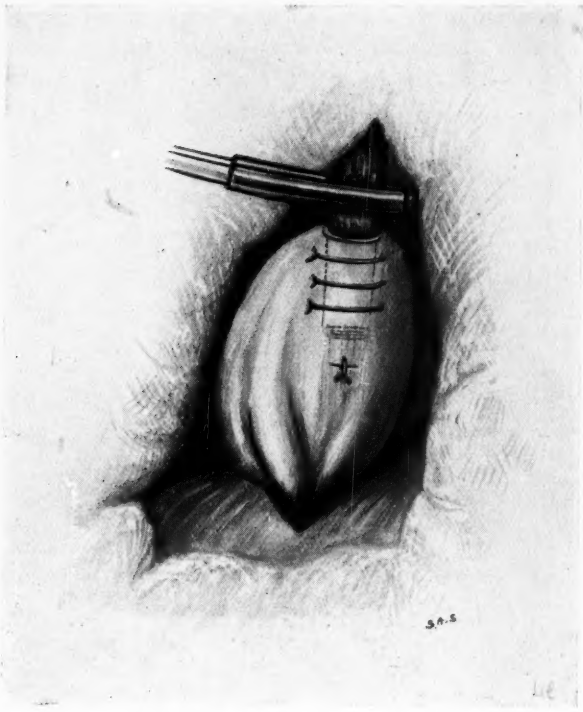

FIG. 95.—The œsophagus is maintained in position by three sutures, and the smaller opening into the stomach closed. (*After Lilienthal.*)

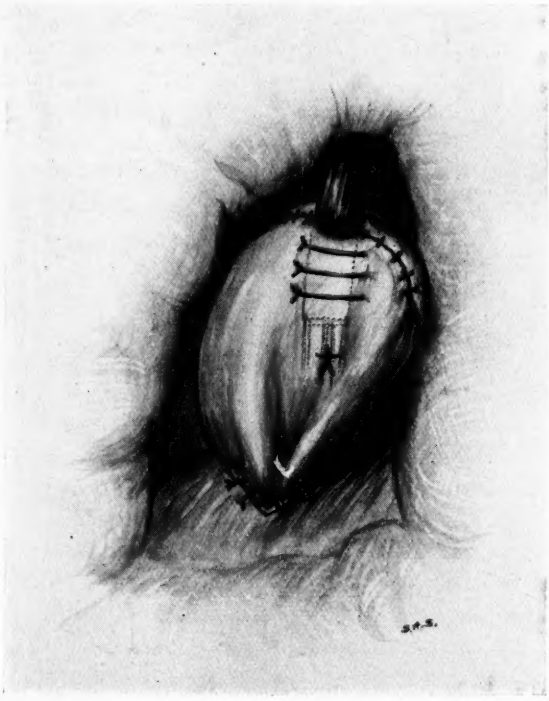

FIG. 96.—The region of the œsophago-gastric junction is invaginated and the stomach sutured to the diaphragm. (*After Lilienthal, slightly modified.*)

(*Fig.* 95). The traction sutures are now cut short and allowed to hang freely in the stomach, the smaller incision into which is closed by a stitch. The region of the stomach into which the œsophagus has been inserted is now still further invaginated by a series of Czerny-Lembert sutures (*Fig.* 96). It is most important that the stomach should be united to the diaphragm where this is pierced; otherwise a large diaphragmatic hernia may develop. I have performed this operation successfully upon a dog but unfortunately neglected to suture the stomach to the diaphragm, and the animal succumbed nearly twenty-four hours later owing to a considerable amount of the abdominal contents passing into the thorax. Post mortem the œsophago-gastrostomy was found to be perfect, and did not leak even under considerable pressure. This operation was devised by Lilienthal,[20] and its extent is shown diagrammatically in *Fig.* 97.

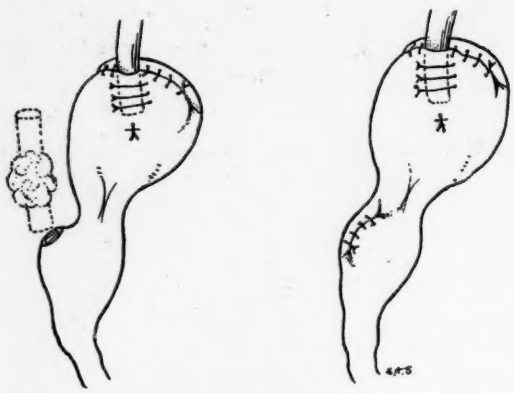

FIG. 97.—Diagram showing extent of Lilienthal's operation. (*After Lilienthal.*)

ABDOMINAL LAPAROTOMY.

Cases of cancer of the œsophagus arising at the cardia, whether primarily œsophageal or primarily gastric in origin, usually demand an abdominal laparotomy in order that their operability may be determined. If a jejunostomy is done as a preliminary operation, the possibility of a radical removal must be estimated at the same time, and, if it is found that an extensive resection of stomach as well as removal of the abdominal portion of the œsophagus is feasible, this may be performed entirely by the abdominal route (*Fig.* 98).

Technique.—An incision is made ½ in. below and parallel to the left costal margin, extending well round to the back. The layers of the abdominal wall are divided in the line of the original incision, and the field of operation is exposed. The table is tilted so that the patient's head is at a higher level than his feet, and a large retractor is passed beneath the costal margin and used to pull this well upwards. If the area of operation is not thus rendered easily accessible, the lower two or three ribs must be divided through the posterior part of the original incision. This now allows a satisfactory view of the fundus of the stomach, the cardia, the abdominal portion of the œsophagus, and the œsophageal opening in the diaphragm. By means of blunt dissection the œsophagus is separated from the diaphragm, and a finger is passed into the mediastinum, separating the œsophagus still further from the loose cellular tissue around it. A previous X-ray examination may have shown dilatation or tortuosity of the œsophagus, and gives a pre-operative idea whether sufficient length of this organ may be drawn downwards into the abdomen. It

may, however, be advisable in either this operation or in that of Lilienthal to perform a section of the left phrenic nerve in the neck as a preliminary measure. When a sufficient length of the gullet has been drawn below the diaphragm a rubber tube is passed around it at the cardia, and this acts as a retractor. The œsophagus is now sutured by one or two stitches to the highest portion of the fundus of the stomach about 2 in. above the upper limit of the growth. One small opening is made into the stomach just below these sutures, and another into the œsophagus. A continuous suture is now taken and passed through all the walls of both viscera, taking up the posterior edge of the upper portion of the partially sectioned œsophagus. When this has been

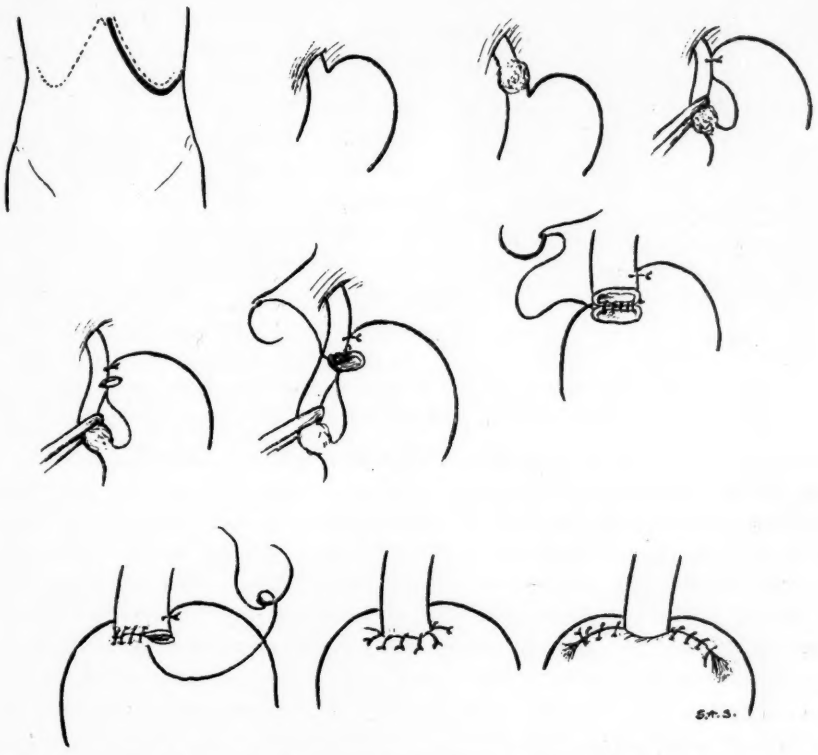

FIG. 98.—Diagram showing a method of removing a growth at the lower end of the œsophagus.

included in the suture the œsophagus is cut across a little further and the suture continued, and little by little the œsophagus is completely sectioned until, when this has been completely accomplished, the posterior half of its wall has been sutured to the posterior edge of the opening in the stomach. All that remains is to pass a suture uniting the anterior part of the wall of each of the two viscera. On either side of the anastomosis a seromuscular gastric suture is now made, causing an invagination of the anastomosed area. The lower end of the œsophagus and adjacent stomach are then removed as widely as possible, and the opening thus made into the stomach is closed and inverted in the usual way. I have three times set out to perform this

operation on human beings, but on each occasion found that, although the œsophagus could be withdrawn sufficiently into the abdomen, the gastric condition had advanced beyond the possibility of a radical removal. I have, however, done the operation twice upon a cadaver with a water-tight result.

Another operation I have performed upon the cadaver which should, I think, be quite feasible upon the living is as follows: The abdomen having been opened as just described, and the œsophagus mobilized and the tumour found to be operable, an incision is made into the stomach about its middle, extending almost from the lesser to the greater curvature. A finger is now passed into the cardia, which is drawn through the gastric opening—that is to say, the lower end of the œsophagus and adjacent stomach are intussuscepted into the remainder of the stomach—and the tumour drawn outwards through the gastric incision. A clamp is then applied a good inch away from the growth, which, together with the adjacent œsophagus and stomach, is removed by means of a cautery. Three or four sutures are passed between the non-intussuscepted portion of the œsophagus and the serous wall of the stomach at the site of intussusception. Now, passing to the area where the œsophagus and stomach have been sectioned, these two are united to each other by means of through-and-through sutures, special sutures being passed in order that the left gastric artery may be securely ligated. Two or three sutures are also passed through the walls of the stomach picking up the intussuscepted portion of the œsophagus. The gastric opening is then closed in the usual way. (*See Fig.* 99.)

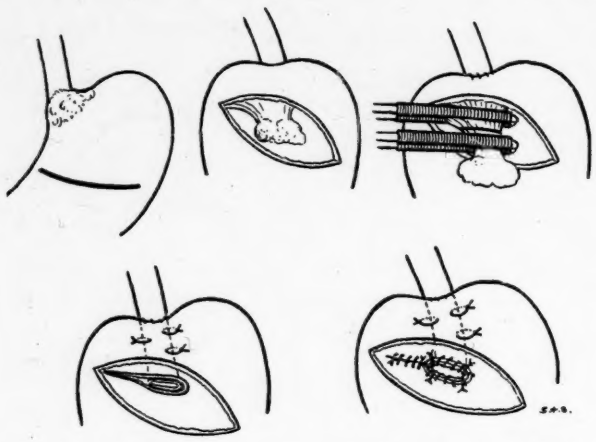

FIG. 99.—Diagram showing another method of removal of growth at the cardia.

COMBINED OPERATIONS.

In Torek's famous case[21] which was demonstrated alive and well a year ago in New York (twelve years after operation),[22] he performed a posterior mediastinotomy with section of the œsophagus *in situ* and invagination of the lower end (*Fig.* 100). An incision was then made in the neck (*Fig.* 101), and the upper portion of the œsophagus containing the tumour drawn through this incision (*Fig.* 102) and passed under the skin of the anterior wall of the thorax, so that it emerged through an incision in the skin at the level of the 2nd intercostal space. The patient still swallows well through an anastomosed rubber tube.

Eggers, of New York, has also had a successful case.[23]

This might be called the combined mediastino-cervical operation. An abdomino-cervical operation has also been performed: the stomach is mobilized after the method of Kirschner,[24] and the œsophagus separated from its diaphragmatic hiatus. The œsophagus having been exposed by the cervical route, it is drawn upon until almost the whole of it emerges through the neck, the stomach coming to lie in the posterior mediastinum (*Fig.* 103). The tumour-bearing area is now excised, and the gullet sutured and replaced into the neck.

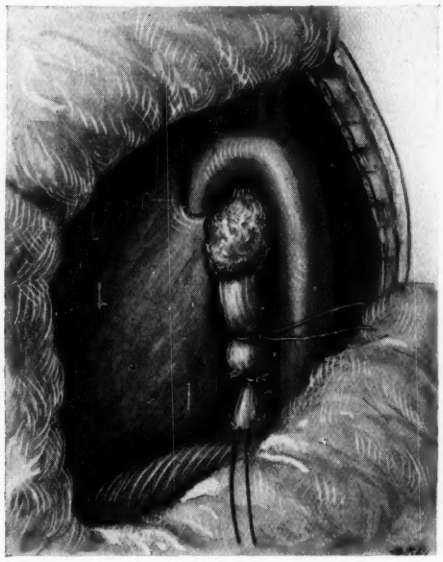

FIG. 100.—Torek's operation. Posterior mediastinotomy, with division of the œsophagus *in situ*. (*After Torek.*)

Levy,[25] of Berlin, suggests Friederich's operation of subperiosteal excision of the last six ribs, thus causing collapse of the thorax so that the œsophagus can easily be reached. The diaphragm is then divided and transplanted upwards. Both the œsophagus and the stomach are now lying close to the skin, and the affected area may be excised, leaving the cut ends of the œsophagus and the stomach extracutaneous, where they may later be anastomosed. A modification of this method was successfully used by Hedblom,[26] and also by Zaaijer.[27]

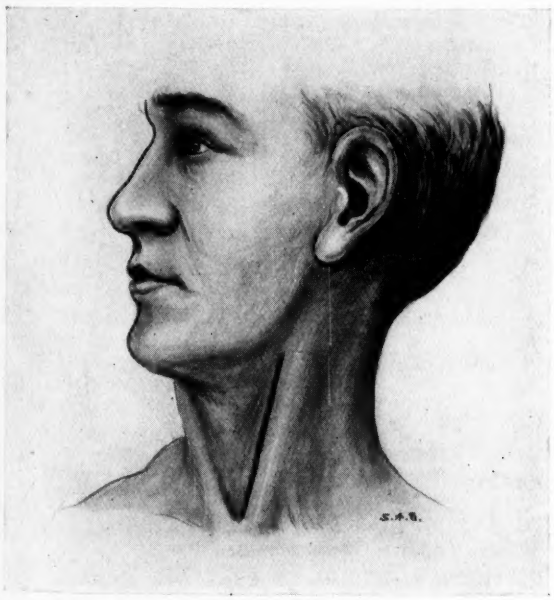

FIG. 101.—Diagram showing line of incision for exposure of the cervical œsophagus.

Another abdomino-cervical operation which has been suggested consists of first exposing the cardia by laparotomy and dividing the œsophagus from the stomach. The gastric opening is closed.

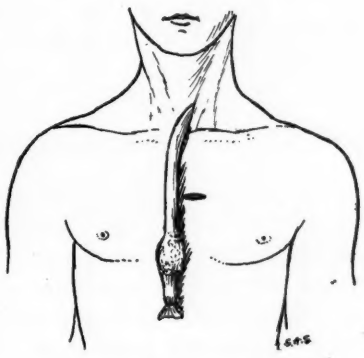

FIG. 102.—The œsophagus withdrawn through the cervical incision in Torek's case. (*After Torek.*)

A malleable sound is now passed from the mouth to the lower end of the œsophagus, to which it is secured by means of a stout thread. The end of the gullet is surrounded by oiled silk, which is tightly tied round it, the ends of this ligature being left long.

Through a cervical incision the œsophagus is exposed, and when traction is made upon the peroral sound the lower part of the œsophagus is intussuscepted into the upper

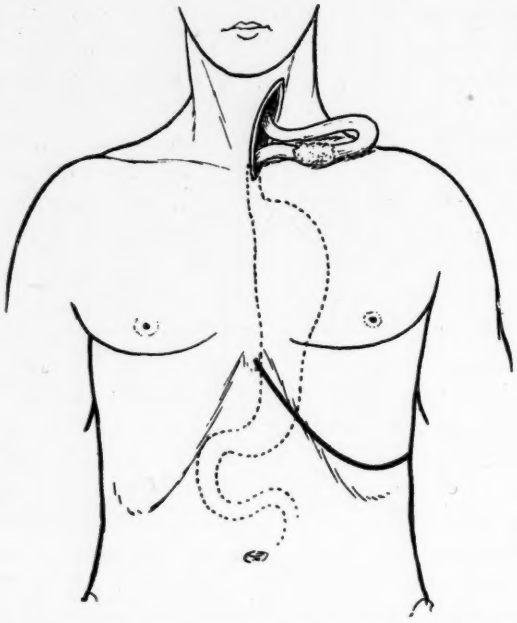

FIG. 103.—Diagram showing exteriorization of the œsophagus through a cervical incision, with displacement of the stomach into the thorax after mobilization.

(*Fig.* 104) and the long ligature appears in the neck. This is withdrawn through the cervical wound, and the whole œsophagus together with its growth exteriorized.

I have performed this operation upon a dog, but consider it of doubtful value in a case of cancer of the œsophagus, when so many much more satisfactory operative procedures are open to us.

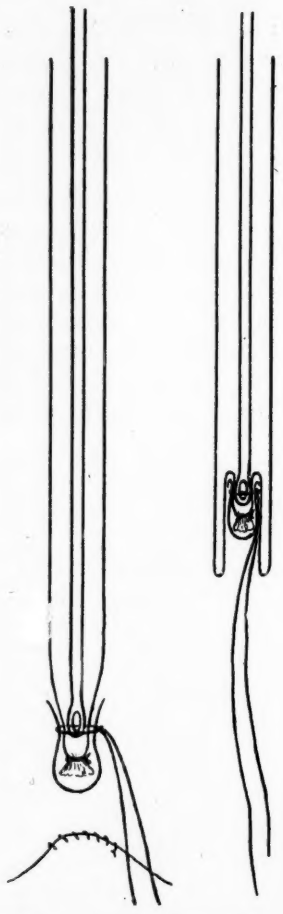

FIG. 104.—Diagram showing a method of displacement of the œsophagus by means of a sound passed through the mouth.

CONCLUSIONS.

As already stated, cancer of the œsophagus gives early symptoms. Further, this particular type of tumour remains localized to the affected organ long after its presence can definitely be diagnosed. Thirdly, glandular metastases from carcinoma of the œsophagus are the exception rather than the rule, and the majority of sufferers from this complaint do not die from carcinoma but from starvation.

It would thus appear that cancer of the œsophagus often is, and almost always should be, diagnosed at a very early date; that its surgical removal should be followed by complete freedom from local recurrence; and that later glandular recurrence should occur only in the minority of cases.

I am strongly of opinion that the operations suggested are feasible. It will be remembered how Billroth began operating on the stomach some forty years ago; many of his patients died, but to-day operations on the stomach are performed by all surgeons with extremely low mortality, and yet our operations and those of Billroth are the same except for very small points of technique. Similarly with growths of the large intestine; at the beginning of the present century these were looked upon as inoperable, whereas at the present time their removal is an everyday occurrence.

With more adequate education and earlier investigation of cases, and the application of the principles which I have enunciated, there would appear to be no reason why malignant disease of the gullet should not be treated so effectively that before long, instead of this disease claiming 100 per cent of its victims as it does at the present time, it will be the most favourable type of cancer with which the surgeon has to deal.

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ANÆSTHESIA OF THE BRACHIAL PLEXUS.

By HENRY W. S. WRIGHT, Tsinanfu, China.

After working for some time in the surgical department of a hospital which has no trained anæsthetist, and where one's colleagues are much too busy to attend to anæsthetics, the value of a reliable local anæsthetic, entirely under one's own control, quickly becomes apparent—so much so that, after one or two experiences with general anæsthetics which nearly ended in disaster, regional anæsthesia is now used as a routine in all suitable cases, whereas previously it was only employed as a last resort in cases too ill to stand a general anæsthetic.

Under such circumstances, when an efficient and reliable technique for producing local anæsthesia has been developed, half the anxiety of a major operation is taken away, and any surgeon will find that the time and trouble required to gain the necessary skill is more than worth while. From the point of view of the patient, if proper psychological precautions are taken, the results are equally satisfactory, for he is saved much post-operative discomfort, which sometimes may even amount to suffering. The eagerness of patients to have a local anæsthetic, after its reputation has got round the wards, is perhaps the best proof of this. Its advantages, however, are not only confined to the patient and his doctor; they are shared by a hard-driven nursing staff, whose work is materially reduced because their post-operative cases have not spent the previous hour soaked in ether. And finally, the operating theatre budget, in China at least, feels its good effects.

Because of the foregoing considerations, and the fact that up till now brachial-plexus block does not seem to have attained the reputation it deserves, I venture to describe the experience gained from a series of 56 consecutive cases.

In his Halsted Memorial Address at Johns Hopkins Medical School, Baltimore, Rudolf Matas[1] mentions that during the winter of 1884–5 Halsted, after injecting cocaine around the nerves at the root of the neck, successfully performed an operation on the brachial plexus. This was the period during which he was doing his pioneer work on local anæsthesia, and it is the first attempt to block the brachial plexus of which I can find any record. In those early days, before novocain was discovered, the method never gained great popularity, probably because people began to realize the danger of injecting cocaine subcutaneously; and Halsted, its originator, was the kind of person who always kept his new ideas to himself until he had proved their worth to his own satisfaction, and, even then, often he did not publish them.

Very little was heard of this method, therefore, until Kulenkampff,[2] about 1910–11, elaborated the technique of supraclavicular injection which usually goes by his name. About the same time Hirschel[3] published a method

of infiltrating the plexus from below; but from all accounts this is not as simple, certain, nor as safe as that recommended by Kulenkampff, and in this series of cases it has not been used.

Others, including Crile, have injected novocain after exposing the plexus through a supraclavicular incision. In view of the good results obtained by Kulenkampff's method, a further complication of the technique seems to be unnecessary, but perhaps might occasionally be required under very exceptional circumstances.

The technique elaborated by Kulenkampff takes advantage of the fact that practically the whole nerve-supply of the arm is gathered together on the upper surface of the first rib, immediately external to the subclavian artery, which nearly always forms a convenient landmark by means of which the nerve-bundle can be located.

It may be objected that in this region there are too many important structures which may be easily injured by blindly inserting a needle. In actual practice, however, it seems to be remarkably free from danger if the technique is carefully followed. The subclavian artery may be adequately protected by a finger placed on its antero-superior surface, from a point immediately outside of which the injection is made. Injury to the pleura is easily avoided if the injection is made immediately paræsthesias are obtained; or, should they not be noticed, the point of the needle must always be made to impinge on the first rib before any solution is injected. Should the needle inadvertently pierce either of these structures, sufficient evidence of the fact is always at hand. In the first case, blood flows rapidly from the needle, and in the second case the patient complains of pain. In this series the subclavian artery was pricked twice: once in a four-year-old child whose artery was impalpable, and once in a fat man whose neck was very thick and short. In both these cases there was no doubt whatever where the point of the needle was, and no harm resulted; the needle was withdrawn, and, after its direction had been corrected, the usual technique was continued. In each case the result was in every respect satisfactory, and there were no untoward consequences of the mishap. That this accident is relatively unimportant is confirmed by the experience of most of those who have used the method.

As regards injury to the pleura, as far as I know, it has not occurred in these cases. Intrapleural injection would almost certainly produce pain or a reflex cough. Hirschel, in his text-book, quotes Heile[4] as having seen one case in which the pleura was injured. There was subsequent pleurisy, which passed off without leaving any ill-effect.

Hartel and Keppler record that paralysis of the diaphragm occurred in 17 out of 200 cases, and suggest that this was due to paralysis of the phrenic nerve on that side. Hertzler,[5] in commenting on this, suggests that the five cases of pain in the chest and dyspnœa which these authors record were really due, not to puncture of the pleura, but to massive collapse of the lung, the result of phrenic paralysis.

In this series of cases we have seen no accidents of this kind, and, although paralysis of the diaphragm may have been overlooked, it certainly produced no symptoms. In fact, the method has seemed to be remarkably free from danger and complications of any kind.

TECHNIQUE.

No special instruments are necessary. A fine 5- or 6-cm. needle, connected to a 20-c.c. Record syringe, is all that is required. A special syringe having a bayonet-fitting excentric joint is more convenient, but by no means essential. The needle, however, should be quite sharp, for if it should by any chance pierce the subclavian artery it will only make a fine hole which immediately closes up by itself, whereas, if its point is blunt, it is conceivable that during its passage through the artery the coats might be torn, a result which at any rate is undesirable. In addition to a suitable syringe, 30 c.c. of 2 per cent and a quantity of $\frac{1}{2}$ per cent novocain solution should be at hand. Adrenalin is added in the proportion of 3 drops to every 10 c.c. of novocain solution used.

Half an hour before the injection is to be made, the patient is given a hypodermic injection of scopolamine gr. $\frac{1}{100}$ and morphia gr. $\frac{1}{6}$. In some patients this time relationship is important, because scopolamine and morphia causes them to over-react to the slightest stimulus, and removes whatever self-control they possess. If administered too late they are frightened by the injection; if given too early, or if two doses are employed, they may be over-excited, and the procedure becomes very difficult.

The injection is as a rule made on the operating table, which should be well padded and comfortable. In summing up his general impressions of the operation, a patient who has been lying on a hard, uncomfortable operating table for an hour is not likely to separate the uncomfortable sensations thus received from those which come from the actual operative manipulations.

The patient's head should be in the middle line, and slight traction should be made on the arm, in order to bring down the clavicle. If, however, the head is turned to the opposite side, and the arm pulled down too much, the skin over the supraclavicular region is sometimes made so taut that the artery cannot be palpated, and thus the best guide to the brachial plexus is obliterated.

There are several ways of finding the correct spot for the injection. The best, and the one nearly always available, is to feel with one finger the subclavian artery. A small intradermal wheal is made 1 cm. above the clavicle, immediately outside the palpating finger. Sometimes, in thin patients, the plexus can be felt and rolled beneath the skin, on the upper surface of the first rib. In other more difficult cases the external jugular vein forms a reliable guide. The patient is told to puff out his cheeks, and the vein stands out clearly. The injection is made from a point 1 cm. above the clavicle, immediately outside the vein. This latter spot corresponds to a point 1 cm. above the clavicle in the exact midclavicular line, and it can be found in this way should the external jugular vein be invisible. While inserting the needle, the anatomical relationships of the first rib should be borne in mind: a help not to be despised is to study a diagram of these for ten minutes beforehand. The direction of the needle is inwards, downwards, and backwards, as close as possible to the subclavian artery. As soon as the needle has pierced the deep fascia it is pushed onwards about $\frac{1}{2}$ cm., and, if the patient is not too sleepy, paræsthesias will be felt. If not, the needle should be gently

moved from side to side in a direction transverse to the main axis of the plexus. If this manœuvre does not produce paræsthesias, the needle should be pushed on till it rests on the first rib, then gently withdrawn a few millimetres, and the novocain injected. For the average patient 15 c.c. of 2 per cent solution are sufficient, but in fat people 20 c.c. may be used; in children 10 c.c. are sufficient. It is the experience of most people that weaker solutions do not produce good results. In addition to this, I have adopted a modification of the original technique which I believe was suggested by Labat.[6] The needle is withdrawn outside the deep fascia and re-inserted in a direction upwards and inwards, towards the transverse process of the sixth cervical vertebra. Five c.c. of 2 per cent solution are injected. This will diffuse upwards and downwards in the loose intermuscular connective tissue where the nerves are to be found. Finally, 5 c.c. are injected just at the outer border of the first rib, in order to block any abnormal branches which may join up here.

When this is finished, a subcutaneous ring of ½ per cent solution is injected round the arm at the level of the deltoid insertion. This serves to block the fibres of the cervical plexus. This subcutaneous ring may perhaps be advantageously placed a few inches above the upper margin of the incision, whatever the position of the latter may be.

If the region of the shoulder-joint is to be explored, it is necessary instead to inject some ½ per cent solution subcutaneously along the line of the clavicle, and also to infiltrate the inner axillary wall as high up and as close to the ribs as possible. Injection fanwise from one suitably-placed intradermal wheal will easily gain this end. In this way the intercosto-humeral nerve, and the clavicular, pectoral, humeral, and supra-acromial branches of the cervical plexus are blocked at a higher level than when a deltoid ring is used.

After the injection is finished, the limb is surrounded with fresh towels and prepared for operation, and by the time this is completed and the surgeon has put on his gloves, anæsthesia will usually be complete; it will last from one to three hours. It is seldom necessary to wait longer than ten minutes. It is sometimes stated that the rapidity with which anæsthesia supervenes is proportional to the ease with which paræsthesias are obtained on injection; but this has not been found to hold good in the present series of cases.

At this stage it is necessary to decide whether a further hypodermic injection shall be given, first-stage general anæsthesia induced, or the operation immediately proceeded with. The decision on this point is made after taking into account the patient's mental condition and psychology. From his point of view it is most important to see to his mental and physical comfort while on the table, for there is no more reason why he should spend an hour in intense mental discomfort than there is for his blood to be saturated with ether for the same period of time. Some patients are perfectly happy and comfortable without any further attention; others require something to quiet their very natural alarm. We have found the following rules very satisfactory for general guidance in all types of local anæsthesia. Sensation is first tested roughly to see whether anæsthesia is satisfactory, and if not, ether is given at once, the injection being counted as a failure. If the patient is wakeful and seemingly uninfluenced by the first hypodermic injection,

another one is given; but if the first injection has produced a talkative, rather excited patient, he is given either ether or chloroform until he goes to sleep. If a careful anæsthetist is available, a few drops of chloroform will gain this end quickly. The patient will then, as a rule, sleep for the rest of the operation without any further medication. This is a most satisfactory method of dealing with patients who are disturbed by their unusual environment, and we never hesitate to use it when there is the least indication.

To estimate accurately the value of a method like brachial-plexus block, and to compare it usefully with general anæsthesia, is a difficult task. To compile a list of cases strictly comparable is almost impossible, so that our impressions must be considered in making a final estimate. After doing it over fifty times, it is impossible to escape the conclusion that a patient is in a better condition at the end of a major operation done after brachial-plexus block than when a general anæsthetic has been used. Even when the results of injection are not perfect from a neurological point of view, sometimes the practical results are most evident. The following case is a good example of this :—

A soldier, age 23, had a gunshot wound involving those larger branches of the brachial plexus situated beneath the pectoralis major. The ulnar, median, musculocutaneous, and musculospiral nerves were all involved in dense scar tissue which obliterated all the normal relationships. Towards the end of the operation, when the musculospiral nerve was being dissected free, a traumatic aneurysm about the size of a walnut was broken into and had to be removed. The whole operation lasted two hours and fifty minutes from the time of injection. The ordinary technique was used, and from the beginning a first-stage anæsthesia was induced with ether, and during the whole period 11 oz. of ether were given by the open method. Dissection of the nerves produced no response whatever, but traction downwards always made the patient call out, probably because it was transmitted to the roots above the blocked area. The patient's pulse at the beginning of the operation was 80 and at the end 90; his general condition showed hardly any appreciable change.

To make a proper neurological examination is very difficult, for Chinese patients do not notice fine points of difference. An intelligent, wakeful patient is very rare. Experience leads me to believe that protopathic and epicritic sensation are nearly always completely abolished, but muscle sense seems sometimes to be retained. Paralysis also is complete or nearly complete in most cases. A recent opportunity to examine one of these incomplete cases showed that painful sensations and muscular power were completely abolished, but pressure sense was present all over the arm, and the patient called out for the first time when hot eusol was poured over the wound. Reaction to cold was not tested, but in other cases it has been abolished when heat sensation was present to some degree over the area tested.

Brachial-plexus block has been found equally effective in all classes of patients. The results in children, as with other types of local anæsthesia, have been most gratifying. The child is anæsthetized, the injection made, and the anæsthetic stopped; he will then sleep until the operation is finished. This procedure, used in a child of 4, with extensive suppurating osteomyelitis

involving the whole length of the radius, was probably life-saving. In one case the brachial plexus was blocked on both sides at the same time. There were no alarming symptoms, and the result was eminently satisfactory.

COMPLICATIONS.

Our experience has been remarkably free from complications of all kinds. Excluding the puncture of the subclavian artery already referred to, there have been only two. One man had paralysis of the whole arm which lasted for twenty-four hours, and then rapidly and completely cleared up. Raeschke[7] records such a case in a boy of 15. The plexus was uniformly involved, but within two and a half weeks movement returned at the shoulder, elbow-joint movements also returned later, and within three months there was no abnormality whatever. There is, as far as I know, no record of any permanent disability to be found in the literature.

The second complication was a reaction which may perhaps be attributed to novocain. Immediately after injection the patient's pulse became soft and rapid (135), and at the same time the respiration was shallow and fast. However, within fifteen minutes she had returned to her former condition, which, incidentally, was none too good. This is the only example of a novocain reaction which we have seen in a series of over 500 operations performed under local anæsthesia.

In two cases a second injection of 10 c.c. was given because, at the end of about ten minutes, anæsthesia was incomplete. In each of these two cases the final result was quite satisfactory.

RESULTS IN THE FIFTY-SIX CASES.

The results of 56 consecutive cases were as follows: in 50 the result may be classed as either perfect or satisfactory, 2 as indifferent, and 4 as failures. Among the four failures were the first two cases on which I had used the method for four years. A third failure was probably due to the use of 1 per cent novocain after reading an article on the dangers of employing too strong solutions. Two cases (one of which is classed as indifferent) were so frightened that it is impossible to say to what extent they were anæsthetic, and these were not suitable subjects for local anæsthesia. In the last case with an indifferent result it was impossible to assign any reason for the failure but inaccurate technique. The patient had already undergone two operations with a satisfactory result as far as the anæsthetic was concerned. The rest will be classified in a little more detail later on. On the whole they were most successful. In only one was a third-stage general anæsthesia necessary, and this but for a few moments in order to permit strong retraction of the deltoid.

In 5 cases ether was given, the average amount being 2½ oz. per hour. This figure includes the case already referred to in which third-stage anæsthesia was induced, and a child who was fully anæsthetized before injection. In 6 cases chloroform was used to produce sleep, the average amount required being one drachm. Lately we have used this more and more freely, without any ill-effects.

RESULTS IN THE 56 CASES OF ANÆSTHESIA OF THE BRACHIAL PLEXUS.

NATURE OF OPERATION	NO.	PERFECT	SATISFACTORY	INDIFFERENT	BAD	REMARKS
Amputation	2	1	—	—	1	Bad result due to fright
Osteomyelitis in upper end of humerus	2	1	1	—	—	Case felt pulling on deltoid; refused anæsthetic
Plating fractured neck of humerus	1	—	1	—	—	Full anæsthesia necessary when deltoid pulled
Neurolysis	3	1	2	—	—	
Open reduction of old dislocated shoulder ..	1	1	—	—	—	
Excision and drainage in compound fracture ..	1	1	—	—	—	
Excision of tuberculous glands in mid-brachial region	1	1	—	—	—	
Excision or arthroplasty of elbow	10	7	3	—	—	
Breaking down adhesions in elbow-joint	2	—	—	1	1	1st case
Operative reduction of fracture of lower humerus	2	1	1	—	—	
Drainage and scraping of sinus	3	3	—	—	—	
Plating fractures of radius and ulna	3	3	—	—	—	In two of these cases both bones were plated
Bone-graft of ulna ..	1	1	—	—	—	
Draining compound fracture of radius and ulna	2	2	—	—	—	
Osteomyelitis	2	2	—	—	—	
Cellulitis and gunshot wound of forearm ..	5	2	2	—	1	
Amputation through forearm	1	1	—	—	—	
Cellulitis and abscess of hand	4	3	—	—	1	1 per cent novocain used
Bone tuberculosis of hand and wrist	6	5	—	1	—	
Amputation of fingers ..	4	4	—	—	—	
Totals	56	40	10	2	4	

In all the cases which are classed above as perfect or satisfactory, the average increase in the pulse-rate during the operation was 11·9. Excluded from this computation are a certain number of cases in which the pulse at the end of the operation was a good deal less than at the beginning. *Fig.* 105 is a composite pulse and temperature chart which shows very well the average reaction of the non-febrile cases in this series.

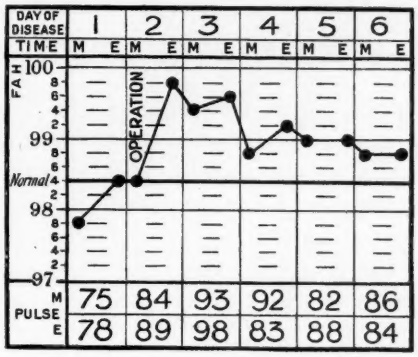

FIG. 105.—Composite chart.

The method finds its most useful application for major operations about the elbow-joint and on the forearm. In operations about the shoulder-joint it is difficult to abolish muscle sense in the deltoid, and retraction of this muscle sometimes wakes the patient. It has been used successfully several times for operations on the hand, in spite of the fact that infiltration of the ulnar and median nerves at the wrist answers the purpose equally well, because of the necessity, in this country, of developing one standardized technique for teaching purposes.

In the table given on the preceding page a case is classed as perfect in which the patient appeared to receive no sensations whatever from the operation area. Those classed as satisfactory apparently retained some degree of muscle sense, but obviously felt no pain. The rest were definitely not completely anæsthetic, so that some other form of anæsthesia became imperative.

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THE SEVENTH CONGRESS OF THE INTERNATIONAL SOCIETY OF SURGERY AT ROME, APRIL, 1926.

THE Seventh Congress of the International Society of Surgery was held in Rome on April 7–10, 1926, the inaugural ceremony taking place at the Campidoglio on the Capitol Hill, and the scientific sessions at the Policlinico. Very lavish care had been spent over the arrangements by our Italian hosts, who showed us the sights of Rome, fêted us, and feasted us in a manner worthy of the Eternal City. There were several sessions devoted to the watching of operations in the various hospitals, and the account given on p. 172 is that of a visit to the wards and operating theatre of Professor Alessandri at the Policlinico. The business meeting of the Congress was notable for the fact that it was almost unanimously decided to reopen the portals of the Society to all those who had been members before the War, when their respective nations had become members of the League. The next Congress is to be held at Warsaw in 1929.

ADDRESS DELIVERED BY HIS EXCELLENCY SIGNOR BENITO MUSSOLINI, THE HEAD OF THE GOVERNMENT, AT THE INAUGURAL MEETING OF THE INTERNATIONAL CONGRESS OF SURGERY.

" I bring the welcome of the Italian Government to you, eminent masters of that surgeon's art thanks to which medical science through the centuries has achieved some of its greatest and most glorious victories. The word which designates your art, gentlemen, does not fully indicate its ideal bearing and human worth. The Greek root of the word 'surgery' has but a modest meaning, 'work of the hand'; but the most luminous qualities of the mind and the deepest energies of character must guide and support that hand in the work it performs with ever-growing success in its efforts to save, with the help of the knife, human lives threatened by disease that is no longer invincible.

" Dating back to most remote ages, your art first rose to the dignity of a science on Italian soil, and, casting off its first profane followers, received its laws and became a science under the learned guidance of the school of Salerno. Proceeding from that school it was honoured in the Renaissance by the four great masters to whom it still looks up with devotion as its most revered patrons, Andrea Vesalio, Wurtzius, Paracelsus, and Ambroise Paré.

" I need not remind you that Paré, as surgeon to Francis II, Charles IX, and Henry III, accompanied their armies in their long campaigns, and when bending over the grievously wounded soldiers he succeeded in saving their fast-ebbing lives, more especially thanks to the system he first introduced of tying the arteries instead of cauterizing them in cases of amputation. When

imminent death retreated before the prodigy of restored life, Ambroise Paré, raising his eyes to heaven, used to exclaim, with exemplary modesty: 'Je le pançai, Dieu le guarist'. But no, he did not only dress the wounds, he cured. And where Death was destroying, Man intervened to restore life.

"The seven volumes of one of the most famous works on the history of surgery are entitled *De Corporis Humana Fabrica.* Masters of anatomy, you are indeed the second makers of the human body. With firm wrist, cunning hand, stern heart, and cool, lucid brain, you have gradually snatched from the insidious attacks of disease most of the obscure regions of the body.

"As a soldier in the great war I had an opportunity of experiencing for a long time your skill on my own body, and so did millions and millions of wounded.

"I greet in you the wonderful saviours of innumerable lives, the victorious heroes of the ambulances. But while soldiers get rest—for even the fiercest wars must have an end—you never rest from your war on disease. Until the last days of your life you remain ever on the field of action, intent in the effort to save the wounded in life's conflict, whose tragic hosts are yet more numerous than those who fall on the field of battle.

"If all men worthy of that name are soldiers in their country's hour of trial, you are the untiring soldiers of the daily battle against disease.

"I am glad to see you assembled in such impressive numbers as our guests in Rome, and beg you to accept, with my cordial greeting, the expression of my admiration and esteem".

A RÉSUMÉ OF THE SCIENTIFIC SESSIONS.

The Treatment of Uterine Cancer by Radiation.—The discussion on this subject was occupied chiefly by details of methods and dosages, and it was difficult to gain any clear idea as to whether early optimism has been justified or not. Regaud (Paris) attaches great importance to the use of radium applied in the vaginal and cervical canals rather than the insertion of needles. He considers that radiation of an infected case involves serious danger of septic complications. In regard to results the following are the percentage figures of cure on a five-years basis:—

	Per Cent
All cases together ..	15 to 20
Inoperable cases ..	5 to 15
Operable cases ..	30 to 40
Early cases ..	40 to 60

He concludes therefore that, except under special circumstances, radiotherapy is to be chosen rather than hysterectomy.

Beuttner (Geneva), whilst admitting the imperfection of present statistical information, considers it proved that radiation gives as good or better results than operation, in early as well as late cases of cancer of the cervix. Cancer of the body of the uterus, on the other hand, gives the best results after hysterectomy.

Recasens (Madrid) devoted his paper chiefly to the intricate and important subject of the dependence of the biological effects of the radiation upon

time and dosage. He held it proved that the application of small doses for short periods caused radio-immunization and rendered effective treatment impossible. The maximum dose of radium applied for a short time caused the greatest biological effect.

Forsdike (London) was much less optimistic than other speakers. He described the results of treatment by radiation in 197 cases. In 7 early cases treated by radiation alone, 6 were well for periods varying from $1\frac{1}{2}$ to 5 years. In 50 advanced cases, only 6 per cent were alive after 4 years. In his opinion radium and X rays should be used before and after operative treatment, but the latter should never be withheld where it is possible.

Abscess of the Liver.—The frequency of amœbic abscesses of the liver is shown by the fact that Domenici (Sassari), who introduced the subject, was able to refer to 264 recent cases. Both he and Petridis (Alexandria) paid tribute to the work of Rogers, especially in regard to the preventive treatment of amœbic abscesses by emetine. By such treatment surgical intervention was often avoided. Petridis described an efficient operation for exploration and drainage of the abscess. He makes a horizontal incision through the chest wall from the mid-axillary line to the outer border of the rectus, dividing the 6th, 7th, 8th, and 9th ribs. The diaphragm is cut in the same line, and the cut edges are sewn to the skin, thus shutting off the pleura from contamination.

The Treatment of Tumours of the Brain.—It is interesting to recall the fact that this was one of the subjects for discussion at the last International Congress of Medicine, held in London in 1913. On that occasion large series of cases were related, and the general problem of whether decompressive or radical operations were really justified by results was debated. On the present occasion discussion was chiefly confined to the details of operative technique, although Sargent's paper, which is presented in full on p. 102, deals with results.

Brun (Lucerne), who introduced the discussion, based his remarks on 458 cases operated on during twenty-three years. He uses local anæsthesia, the patient sitting up and resting the head on the folded arms. The scalp is only partly shaved, towels being sewn round the margin of the shaved area. After trying all sorts of saws and other mechanical devices, he has come back to the use of Krause's bone-cutting forceps introduced through a small drill-hole. The flap of bone raised is always a large one, but the incision through the scalp is made a few centimetres at a time, and every bleeding vessel caught with Kocher's forceps or tied. Similarly each part of the groove in the bone is plugged with gauze wrung out of hot iodoform-impregnated gelatin. After the whole flap has been cut down to the dura, a small cut is made into each side of its base, and the decision arrived at whether to proceed or to wait for a second-stage operation. Nearly always the whole operation is done in one stage, although a pause is made after the cutting of the flap, the patient being given a drink. If a two-stage operation is done, the bone is not separated from the dura until the second stage, so as to avoid obscuring the latter by blood-clot. Primary water-tight suture of the dura is regarded as essential; any loss of dura is made good by flaps of aponeurosis or flaps of fatty tissue.

De Martel (Paris) also dealt only with the technical aspect of the question. He agrees with Brun in the importance of absolute hæmostasis and in the use

of local anæsthesia, but he lays stress on speed of operating, and for this end he uses a special motor-driven saw. The dura should not be opened until cerebral tension has been reduced by lumbar or ventricular puncture or by intravenous hypertonic injection. It was urged that ablation of a tumour should always be attempted, decompression being reserved for hopeless cases.

Lozano (Saragossa) laid stress on some of the same points as de Martel, namely, the advisability of attempting extirpation of the tumour rather than trusting to decompression; the desirability of using a one-stage rather than a two-stage method; and the importance of not operating under conditions of greatly raised intracranial tension. He considered that the mortality of operation for tumours in the anterior parts of the brain is 40 per cent, and of the posterior parts 65 per cent, whilst late recoveries total about 20 per cent for all cases. In some inoperable tumours radiotherapy is capable of relieving such symptoms as vomiting, headache, and convulsions.

The Treatment of Trigeminal Neuralgia.—Adson, of Rochester, Minn., read a paper on this subject, illustrated by a cinematograph film. It is a matter of importance to distinguish true trigeminal neuralgia from other conditions causing unilateral pain—e.g., migraine, glossopharyngeal neuralgia, and sphenopalatine neuralgia. Alcohol injection is regarded as merely palliative, giving relief for a period of about six months. Radical operation, by division of the sensory root of the Gasserian ganglion, is regarded as the standard treatment which should be carried out in every case when the diagnosis is certain, unless age, debility, or intercurrent disease makes it dangerous. The operation is done under combined local and general anæsthesia, the latter being given only during the actual exposure and division of the sensory nerve-root. A vertical incision is made in front of the ear, the temporal muscle is split in the same line, and the bone removed from the middle cranial fossa for a diameter of about 3 cm. The dura is elevated, the middle meningeal artery ligatured, and the outer border of the Gasserian ganglion defined. The motor root, which lies ventral to the sensory and on its mesial side, is avoided by traction on the more superficial sensory root, which is alone divided.

The total number of cases treated had been 839, of which 448 were males, and 391 were females. The average age was 55 years, the youngest being 17 and the oldest 88. The average duration of symptoms was seven and a half years. The different divisions of the nerve were effected alone or in conjunction with other divisions as follows: 1st division, 253 cases (30 per cent); 2nd division, 439 (52 per cent); 3rd division, 551 (65 per cent). In 541 cases the right side was affected, in 285 the left side, and in 13 both sides. Of the 839 cases, 587 were subjected to radical operation, 371 of such operations consisting in simple division of the sensory root.

The number of deaths was 15: hæmorrhage 1, meningitis 3, pneumonia 3, cerebral hæmorrhage 2, pulmonary embolism 2, cardiac failure 2, other conditions, diabetes, nephritis, etc. 2. The complications were: inflammation of the eye 47, including 6 cases of permanent corneal opacity, and 2 in which enucleation was necessary; impairment of hearing 4; temporary facial paralysis 4.

Jacksonian Epilepsy.—Leriche (Strasburg) made a very interesting communication based on the study of 30 cases of traumatic Jacksonian epilepsy.

His two chief points were: (1) That lesions of the bones and meninges are of very little importance, the real causative condition being a fibrous scar in the cortical substance; (2) That when it is impossible to define or remove this cerebral scar tissue, much may be done to ameliorate the symptoms by the regulation of intracranial pressure either by intravenous injection of distilled water or by the ingestion of hypertonic solutions.

The Surgery of the Spleen.—The discussion on this question was rendered difficult by the fact that the subject itself was so large and diffuse that it required the presentation of lengthy monographs by the various participants, who, in speaking, could only touch on a few points. The chief contributors were Cotes Llado (Seville), Patel (Paris), Leotta (Bari), Papayoannou (Ghezireh), and Henschen (St. Gall). The last-named presented a monograph of 189 pages, giving an admirable summary of our present knowledge. He also showed a beautiful series of X-ray pictures portraying the injected vessels of the spleen with their connections with those of the stomach and pancreas.

In addition to the ordinary indications for splenectomy there was a general agreement that purpura hæmorrhagica could be cured by this method; but doubt was thrown on the suggestion that removal of the spleen led to an increase in blood-platelets. Another point of importance mentioned by several speakers was the advisability of being content with ligature of the splenic vessels in those cases demanding splenectomy in which dense adhesions rendered this operation one of exceptional danger.

PROFESSOR ALESSANDRI'S CLINIC IN ROME.

The Policlinico Hospital in Rome is the largest hospital in the city, and the one in which all the clinical teaching of the University takes place. It is about thirty-five years since it was built. On one of the pavilions facing the Via Policlinico is the famous Lister frieze.

There are about 1300 beds, which are divided between what one might call the City Hospital and the University Clinics. The upkeep of the City Hospital falls on the Municipality, that of the Clinics on the Government, but they are both under the same administrative authority.

The City Hospital has 11 divisions, comprising 3 surgical divisions, 3 medical, 1 for nervous and mental diseases, 1 for infectious disease, 1 obstetrical and gynæcological, 1 dermatological, and 1 for ear, nose, and throat cases. These are served by an X-ray department and a pathological department, both being common to all the divisions.

In the City Hospital the general surgical divisions have each 75 beds. These are each under a chief surgeon, who has a first and two second assistants. These assistants can stay on as long as they wish until they get a better post. All the surgical staff are allowed to do private practice.

Each University Clinic is complete in itself. The University Surgical Clinic contains 120 beds. Professor Alessandri is the Professor of Clinical Surgery; he has one first and two second assistants. The second assistants are appointed for two years, and the first for three years. The posts are whole-time posts, and the appointments being made only by examination are therefore competitive.

Each Clinic is complete with research laboratories, X-ray department, library, museum, and any other special department which may be necessary, such as photographic and cinematographic departments. There is one University Pathological Institute in the Hospital which serves the University Clinics during term time. During the vacation the Director of the Pathological Department of the City Hospital is responsible for the pathological investigations required by the clinics. The surgical divisions of the City Hospital have no research laboratories attached. All the students must do their clinical work in the University Clinic, though they may also attend the practice in the surgical divisions of the City Hospital.

There are about 400 medical students in Rome. The course lasts six years, the last three being spent in clinical work and pathology. All the teaching is done at the University Clinics in the Policlinico ; this is the only teaching hospital in Rome. The City Morgue adjoins the hospital, and the instruction in medical jurisprudence is given here. The Public Health instruction is not given in the Hospital. The University Professor of Surgery gives three clinical lectures and operates three times a week. The lectures on systematic surgery are given by the Professor of Surgical Pathology. The lecture rooms are large and well lighted, and the students are so placed that they can see the patients. The demonstration theatre is complete with lantern and cinematograph fittings.

FIG. 106.—Professor Alessandri.

All the patients admitted to the Policlinico Hospital pay at the rate of 30 lire a day (5s.). If the patient is unable to pay, then the Hospital Authority sends an account to the Municipality ; the latter pays, and gets the money from the patient if possible. No patient is allowed to go into the Hospital, except in cases of accident, if he has an income of more than 20,000 lire a year (£160). He must then go into a private clinic.

The three surgical and medical divisions are on duty for emergencies and accidents on successive days. The University Surgical Clinic is never on duty and always on duty. The first assistant of the University Clinic can take any case which comes into the Hospital if he deems it useful for instruction in the Clinic. When the case has been demonstrated it can be sent to the surgical division which happens to be on duty for the day. The

same applies to other cases which may become in any way chronic; in this way there is a continuous change of cases, so that during the clinical course the student sees the greatest number of cases. This is true also of the Out-patient Department. The University Clinic selects for this Department only those cases which are thought to be worth following up. The University Clinic can admit any case solely for teaching purposes, and the Government pays the Hospital Authorities for the maintenance of these patients. The Orthopædic Clinic with 45 beds is run separately from the general Surgical Clinic under a separate professor.

OPERATIONS BY PROFESSOR ALESSANDRI, APRIL 8.

1. Splenectomy for Enlargement of Spleen due to Chronic Malaria.—(*Operation* 8.45 *to* 9.25.) The splenic tumour had been present a long time; recently it had become more palpable, and it was thought that a cyst or neoplasm was present. In addition, the tumour was demonstrated on a skiagram taken after the introduction of air into the peritoneal cavity. An incision was made through the left rectus muscle. The tumour was not a cyst, as no fluid could be withdrawn by a syringe, nor was it a neoplasm. It was merely an irregularity on the surface of the spleen. It was decided that splenectomy should be done. There were many adhesions. The pancreas was very adherent and separated with great difficulty. It was necessary to leave a long plug *in situ* to control the oozing from the surface of the diaphragm. The anæsthesia was ether by the open drop method.

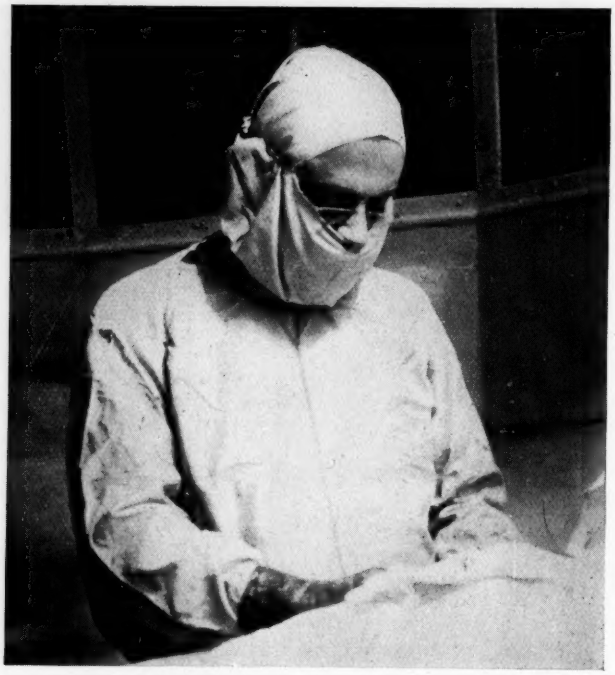

Fig. 107.—Professor Alessandri about to operate.

2. Hysterectomy for Multiple Fibroids.—(*Operation* 9.40 *to* 10.30.) The anæsthesia was intraspinal by tutocaine and adrenalin given between the 12th dorsal and 1st lumbar vertebra. The patient was an old woman, and immediately after the injection she was placed in a very high Trendelenburg position. The anæsthesia was perfect, and there was no shock.

3. Partial Gastrectomy for Perforating Ulcer on the Lesser Curvature.—(*Operation* 10.40 *to* 11.30.) The anæsthesia was intraspinal by tutocaine and adrenalin given between the 12th dorsal and the 1st lumbar

spine. The incision was made through the linea alba. There were no adhesions. The union of the jejunum to the stomach was made by the anterior Polya method. The stomach was divided before the first row of sutures was inserted. Thc appendix was not removed, nor the rest of the abdomen explored.

4. Hydatid Cyst of the Right Lobe of the Liver.—(*Operation* 11.40 *to* 12.15.) The pre-operative diagnosis was hypernephroma of the right kidney. The anæsthesia was intraspinal by tutocaine and adrenalin injected between the 12th dorsal and 1st lumbar spine. The cyst was opened and evacuated and drained through the lumbar incision.

5. Removal of Solitary Cyst from the Lower Pole of the Kidney, and Stone from the Upper End of the Ureter.—(*Operation* 12.20 *to* 1.) The pre-operative diagnosis was stone in the right ureter and pyonephrosis. The skiagram showed the stone in the upper end of the right ureter. The anæsthesia was intraspinal with tutocaine and adrenalin injected between the 12th dorsal and 1st lumbar spine. The kidney was exposed through a lumbar incision. The lower pole of the right kidney was found to have a large cyst about as big as a grape-fruit. At first it was thought to be a hydronephrosis, but later judged to be a cyst separate from the pelvis of the kidney. The cyst wall was excised, and the stone then removed from the ureter. The ureter was closed with catgut, and the kidney dropped back into position.

The anæsthesia in each case was perfect. It was stated that tutocaine was much preferred to stovaine on account of the action being more certain and the after-effects of headache and vomiting less. There was certainly no clinical sign of shock during the operation or at the end.

SHORT NOTES OF RARE OR OBSCURE CASES

GIANT MECKEL'S DIVERTICULUM (33½ inches long).

By H. H. MOLL, Leeds.

This case is noteworthy on account of its unusual clinical features during life and the anatomical abnormality found post mortem—namely, a very large diverticulum of the small intestine..

History.—An infant, 5 months old, was admitted under the care of Dr. Vining for severe attacks of melæna. A first attack, sudden in onset, occurred two days after birth, a second hæmorrhage took place two months afterwards, and a third just before admission. When admitted, the child appeared very blanched, and the blood-count showed a very severe type of secondary anæmia. Repeated small injections of blood taken from the father were given intramuscularly and improved the child's condition, and the patient was duly discharged from the hospital.

The infant was, however, re-admitted two and a half months later for another severe attack of melæna. This time a diagnosis of polypus of the intestine was suggested, and a laparotomy was performed which revealed free fluid in the abdomen and enlarged mesenteric glands. The condition was taken to be tuberculous, and the abdomen was closed. The child died a few days after the operation.

Post-mortem Examination.—On opening the abdomen the peritoneal cavity was found to contain a few ounces of clear, straw-coloured fluid. The lower part of the ileum had a double-barrelled appearance which at first was thought to be due to matting together of two coils of intestine, as seen in tuberculous peritonitis. On closer inspection, however, one of the two coils proved to be a very large diverticulum arising from the ileum two feet above the ileocæcal valve. The diverticulum showed all the layers of the small intestine, and communicated with the main channel of the gut by a large opening about an inch in diameter, lying on the antimesenteric border of the ileum. At the junction of the diverticulum with the ileum were two chronic ulcers which probably had been the cause of bleeding during life.

The diverticulum crossed over the ileum to become attached to its mesenteric border and thus accompanied the gut upwards for 33½ in., terminating blindly. A well-marked stitch-work, very typical of physiological adhesions, bound the diverticulum to the gut, and blood-vessels, branches of the ileocolic artery, were seen coursing across the ileum to supply it. No communication between the two channels, other than the one described, was detected even after the water test; nor did the ileum present any breach of its

muscular coat which might have given rise to a hernial protrusion of the mucous membrane.

Except for a retention cyst, the size of a hen's egg, in the left pleural cavity, all the other organs were normal.

The photograph (*Fig.* 108) shows the diverticulum curled up inside the ileum. A ligature has been tied an inch above the junction of the diverticulum with the gut, and the small intestine has been laid open in order to expose the opening of the diverticulum into it.

FIG. 108.—The diverticulum curled up inside the ileum.

COMMENTARY.]

The diverticulum described above is clearly of congenital origin, but owing to its unusual length some doubt arises as to its being a true Meckel's diverticulum. Although the normal length of a Meckel's diverticulum varies between one and four inches, it may sometimes exist only as a nipple-like protrusion, whilst in other cases it may attain a considerable length. The maximum lengths so far recorded by the particular observers are as follows: Cunningham 5½ in., Lamb 7 in., Rokitansky 10 in.

Pollard described a diverticulum of the small intestine 36 in. long, but did not attempt to classify it. He gave the following description of the specimen: "At a distance of 24 in. from the pylorus the intestine bifurcates. The two segments are similarly supplied with mesentery, so that it is only by tracing them that the true intestine and the diverticulum can be distinguished. The diverticulum after a course of 36 in. reaches the umbilicus, beyond which it originally terminated as a large cul-de-sac in the umbilical

cord. The other segment of the intestine terminates at the ileocæcal valve after a course of 63 in."

The present specimen presents certain features which lead one to think that it is of a true Meckelian type. It occupies the usual site, since it arises

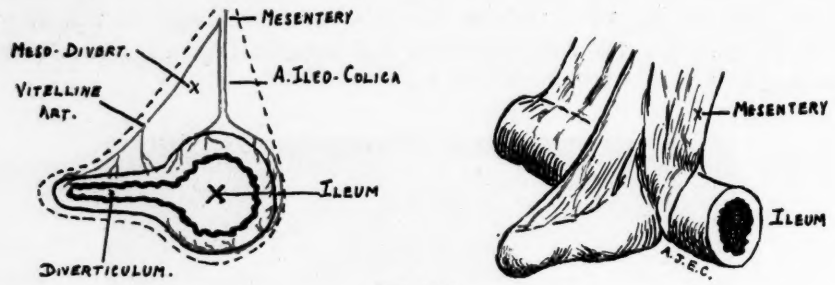

FIG. 109.

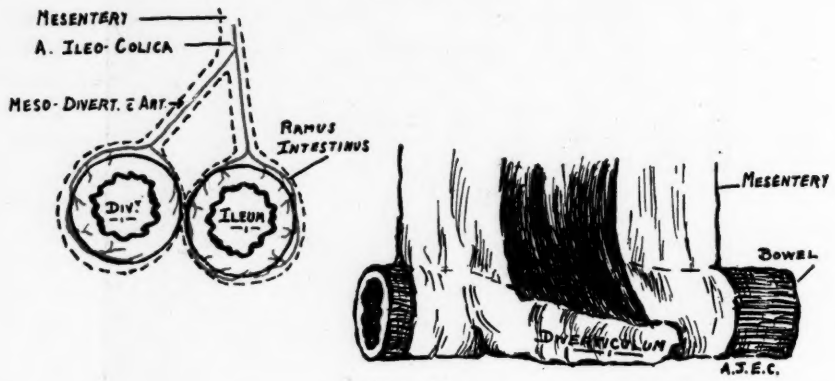

FIG. 110.

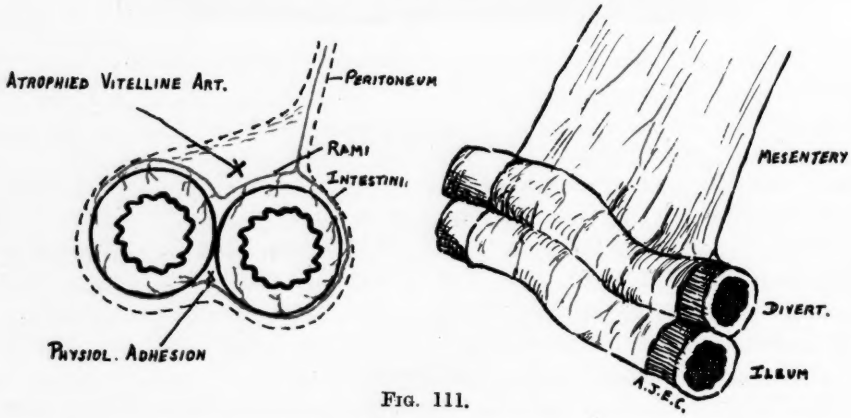

FIG. 111.

FIGS. 109–111.—Probable stages in the development of the diverticulum.

two feet above the ileocæcal valve; it opens into the antimesenteric wall of the intestine, and only later crosses over the gut to become attached to its mesenteric border. The diagrams illustrate how this may have occurred. In the first instance the diverticulum arises from that side of the gut most remote

from the mesentery, and is provided with a mesodiverticulum containing the vitelline artery (*Fig.* 109). Secondly, the vitelline artery undergoes obliteration and shortening, thus drawing the diverticulum alongside the bowel and upwards towards its mesenteric border (*Fig.* 110). Finally, the diverticulum acquires physiological adhesions to the bowel, loses its old vascular supply, and develops a new one from the bowel arteries (*Fig.* 111).

Such a mode of development may possibly explain why the diverticulum, which is seen to arise primarily from the antimesenteric border, at a later stage acquired connections with and appears to extend through the layers of the mesentery. This departure from the usual evolution of a Meckel's diverticulum, although rare, is not unknown in the literature, and seven cases have been recorded in which the diverticulum lay on the mesenteric border of the bowel from which it sprang. The unusual length of the diverticulum may be also explained by a premature withdrawal of the bowel into the abdomen.

I am indebted to Dr. Vining for kindly allowing me access to the clinical notes, and to Dr. Cave for the drawings.

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ACUTE PERFORATION OF A DUODENAL DIVERTICULUM.

BY K. W. MONSARRAT, LIVERPOOL.

A LADY, age 58, felt a 'twinge' of pain to the right of the umbilicus, at 1.45 p.m. on Feb. 7, 1926, fifteen minutes after eating and enjoying her midday meal. The pain gradually increased and passed round to the right loin. About two hours after the attack commenced she vomited twice. The pain became very severe, and was continuous. Dr. Riddell, of Blundellsands, saw her about 6 p.m., and I saw her with him at 8 p.m. She then stated that she had had 'indigestion' for many years, the pain coming on about three hours after meals and being relieved by meals. About a fortnight before the present attack she had been kept awake for three nights by sharp attacks of 'flatulence', which gave her discomfort in the epigastrium and back.

At 8 p.m. her pulse-rate was 100, her temperature 96·8°, and her respirations were 24. She was acutely distressed by persistent abdominal pain, entirely to the right of the middle line, for the most part below the right ribs and in the right loin. The abdominal muscles on the right side showed a persistent board-like rigidity, the liver dullness was normal, and the flanks were resonant. Pelvic examination was negative. Diagnosis: acute cholecystitis.

OPERATION.—At 9.30 p.m. the abdomen was opened through the right rectus muscle; about 3 to 4 oz. of clear straw-coloured serum escaped; no

free gas. The gall-bladder was inspected and found normal; the first part of the duodenum showed a chronic ulcer without recent reaction on the anterior wall. The appendix was inspected and found normal. An intense peritoneal injection was noted over the second part of the duodenum, and marked œdema of the subperitoneal tissues to the outer side of the duodenum. Some yellowish exudate was seen through the peritoneum in this region. The peritoneum was incised, and serous fluid escaped containing yellowish flaky material, with fæculent odour. Underlying this exudate a perforation was found in what at first appeared to be the duodenal wall; but on further dissection with the finger a diverticulum was isolated, and the perforation found to be at the apex of this. The diverticulum when delivered was the size of a damson, and possessed a definite stalk about half an inch long. The stalk was ligatured and the stump buried in the duodenal wall. The incision in the parietal peritoneum was not sutured; a cigarette drain was passed down to this incision.

The patient made a smooth recovery.

On opening the diverticulum it was found to contain a yellowish paste-like material with the odour of a *B. coli* culture. On analysis this material proved to be an inspissated mucus, and on culture *B. coli* and 'a non-lactose-fermenter' were isolated. Histologically the diverticulum showed the structure of normal small intestine with villi.

DIVERTICULUM OF THE STOMACH.

By J. W. THOMSON, Wakefield.

H. B., age 45, was admitted to the Wakefield Hospital in November, 1925. His general condition was poor. Thirteen years previously appendicectomy had been performed, and for eight or nine years he remained in good health. He then began to suffer from pain after food and occasional vomiting, especially after breakfast. His condition gradually became worse. In October, 1924, laparotomy was performed by a right paramedian incision. An adhesion, well marked, stretching from the direction of the cardia to the pylorus, and dragging on the latter, was divided. A diverticulum, as suggested by a skiagram, was not discovered. There was no improvement in the condition of the patient. The case was again referred to the radiologist. (*Figs.* 112–114.)

Fig. 112.—One hour after barium meal.

OPERATION.—The abdomen was opened by the Navarro-Baudet incision, the subcostal part of this in the first place. Adhesion of the posterior wall of the stomach over a small area close to the œsophagus was discovered. The Navarro-Baudet incision was completed by the transgastric route, and the diverticulum was located on the posterior wall of the stomach about an inch below, and somewhat internal to, the cardiac orifice. The opening was rounded, and just admitted the index finger. Its edges were thin, sharp, and rigid. The finger passed into a shallow, almost circular, barium-coated

FIG. 113.—Four hours after barium meal.

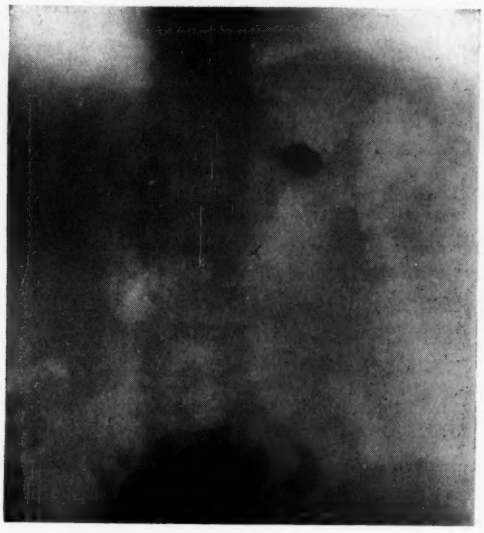

FIG. 114.—Eight hours after barium meal.

cavity, of which the diameter may have been an inch. On further examination, the rigid ring split to the right and to the left.

My intention had been to invert the diverticulum and remove it, but this was totally impracticable. The splitting of the orifice at once suggested the line of treatment, which was to exclude the diverticulum. Two methods of treatment might be considered: (1) Exclusion; (2) Inclusion or inversion.

The pathological report states that there was thinning of all the coats.

AN APPARENT CASE OF PRIMARY EPITHELIOMA OF BONE.

BY G. PERCIVAL MILLS, BIRMINGHAM.

ON April 16, 1923, W. G., age 27, came under my care at the Royal Orthopædic and Spinal Hospital, Birmingham, for ankylosis of both hips due to old tuberculous disease. During examination it was discovered that he had a swelling of the lower end of the right femur, and he then admitted that he had noticed it for four months, but had attached no importance to it. The swelling was about the size of a small orange, had a well-defined edge, and was firm but not bony hard in consistence. There was no egg-shell crackling,

and the projection was more obvious on the posterior surface of the bone. The inguinal glands were enlarged and hard. The right knee was ankylosed. The skiagram showed absorption of the posterior half of the lower end of the femur, with some small pieces of necrotic bone. There was bony ankylosis of the knee.

On April 24, in view of the uncertainty of the diagnosis, it was decided to remove a portion of the tumour for examination. It had a definite false capsule, was firm on section, and of a yellowish-white colour. It was not unduly vascular, and contained no big veins. The pathologist's report (Professor Haswell Wilson) was : " Basal-celled epithelioma, primary elsewhere ". During subsequent discussion Professor Wilson informed me that it was a type of tumour he had frequently seen growing at the bottom of an old bone sinus, and such as had previously been mistaken for a primary epithelial tumour of bone. There was, of course, no sinus present in this case.

On May 18 the patient developed a left-sided pleurisy with effusion, which was naturally regarded with great suspicion. It subsided in a few weeks, however, and he became apparently perfectly well.

As an ordinary clinical examination revealed no signs of a primary growth, I had the patient removed to the General Hospital for a fuller investigation. Mr. Musgrave Woodman kindly examined the nose and throat for me, and reported that there was no tumour in the larynx or in any of the nasal sinuses, while radiological examination of the gastro-intestinal tract showed no abnormality.

On July 21, as no primary growth could be found, I amputated just below the hip-joint and dissected out the enlarged glands from the groin. Convalescence was uneventful, and on Aug. 18 he was discharged from hospital apparently well. The pathologist's report agreed with the previous one. A few months later he began to complain of pain in the right shoulder and the right hip, though there was no clinical evidence of disease in these situations. He was then lost sight of for a few months.

On Nov. 5, 1924, fifteen months after amputation, he was re-admitted. He then had a large swelling involving the outer third of the right clavicle and the adjacent part of the acromion process. The swelling was hard round the edges, but soft and almost fluctuating in the centre. There was also an indefinite swelling in the region of the right iliac bone.

On Nov. 8, 150 mgrm. of radium were inserted into the clavicular swelling for twenty-four hours. The central part of the growth was diffluent, like the contents of a sebaceous cyst, and some of it escaped during the operation. In spite of this the immediate effect was good : the wound healed readily, the tumour shrank to about one-third of its previous size, and the pain in the shoulder was much relieved. On returning home the patient gradually became much weaker, and on Dec. 26, 1924, he was re-admitted. The mass in the right iliac bone was then very obvious, and appeared to involve the whole of the bone. The left side of the chest was dull, with absence of vocal fremitus and vocal resonance, while the breath sounds were almost inaudible. Pain in the right hip and left chest was extreme, and he had to be kept constantly under morphia. He died on Jan. 17, 1925.

POST-MORTEM EXAMINATION.

By Professor Haswell Wilson.

"*External Appearances.*—The body is that of an extremely emaciated young man. The right leg has been amputated through the upper third of the thigh. There is a swelling round the right hip, extending backwards towards the sacrum. The left leg is flexed and rotated inwards from the hip, and shows wasting of extreme degree.

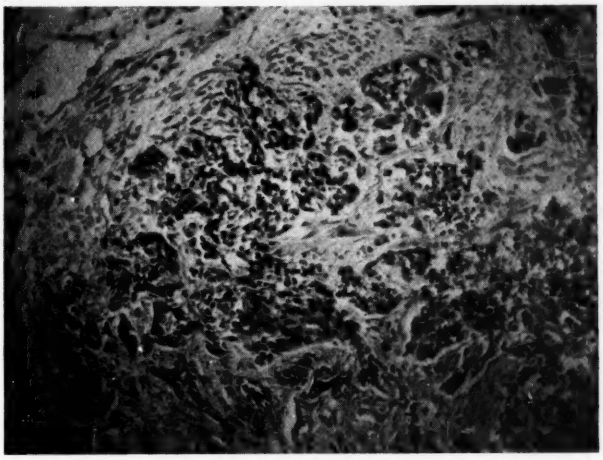

Fig. 115.—Low-power view of original tumour.

"*Thorax.*—Pericardial sac is occluded by abundant recent fibrinous exudate. There is a nodule of metastatic tumour bulging into the base of the pericardium posteriorly. This is continuous with a swollen mass of infiltrated glands at the root of the left lung.

"Heart weighs 220 grm. The muscle is distinctly atrophied. No lesion is found in the valves or cavities.

"The left pleural cavity is obliterated by old fibrous adhesions. The lung substance is poorly aerated. Its substance is firm and fibrous in consistence, and a considerable degree of bronchiectasis is present. The dilated bronchi contain mucopurulent material, and there are a number of recent abscesses scattered through the lung substance. At the root of the lung the glands are swollen and infiltrated by pale, rather soft tumour tissue. The main bronchus is completely encircled by the mass of enlarged glands, and the growth has fungated into its lumen, which is obstructed. No tumour is found in the lung substance. The right lung is free from adhesions. The upper lobe is emphysematous, and some chronic bronchitis is present. The base is congested and œdematous, and early hypostatic pneumonia is present.

Fig. 116.—Showing imperfectly formed 'cell-nests'.

"*Abdomen.*—Peritoneum normal. Liver, spleen, and kidneys show no gross abnormality.

"Enlarged infiltrated glands are found in the prevertebral tissues from the sacrum up to the posterior mediastinum. At the brim of the pelvis the enlarged glands merge into a large mass of soft pinkish tumour lying in front of the sacrum and infiltrating the adjacent muscles and nerves. This extends outwards through the right sciatic notch and infiltrates the tissues round the right hip-joint.

"A secondary tumour about the size of a hen's egg is found on the outer end of the right clavicle, where a spontaneous fracture has occurred, and from this there is extension into the surrounding tissues. No lesion is found in the brain or spinal cord.

"With a view to determining the origin of the tumour in the leg, the following regions were carefully searched for a primary growth, with negative result: The whole cutaneous surface of the body (except the amputated leg); the mouth, pharynx, ears, and nasal sinuses; the entire alimentary tract with the related glands, and the anal margin; the respiratory tract and mediastinal tissues; the thyroid and tissues of the neck; the urinary tract, prostate, and testicles; the suprarenals; the central nervous system and ependyma.

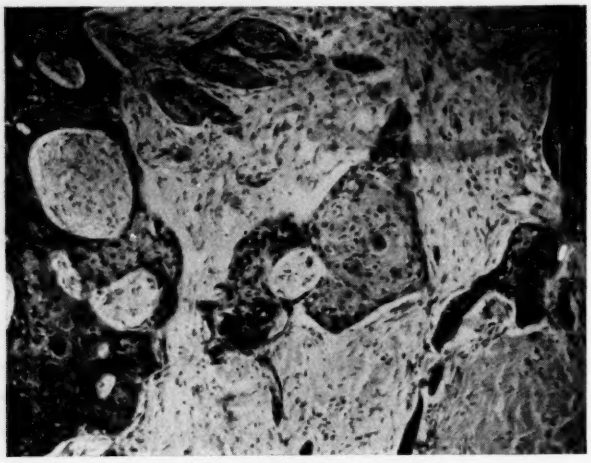

FIG. 117.—Higher magnification of tumour.

"The histological report on the original specimen removed in the Royal Orthopædic Hospital is as follows:

"'This tissue is invaded by a malignant tumour with the characters of a basilar epithelioma.

"'The histological picture closely resembles that of some of the slowly-growing epithelial tumours of the skin. The greater part of the tumour consists of more or less spindle-shaped cells, with comparatively little tendency to keratinization. In places, however, there is definite keratinization, with imperfectly formed cell-nests. The tumour infiltrates widely, and the cells lie in a very dense fibrous stroma.' (*Figs.* 115, 116, 117.)

"Further sections were made from specimens obtained post mortem. The pelvic mass, the tumours in the bronchial glands, pericardium, and right clavicle all show a structure essentially similar to that of the original section, with varying degrees of keratinization. In all of them the structure is definitely that of a squamous epithelioma, and in none of the sections is there anything to suggest that the tumour has taken origin from anything other than epithelium."

The post-mortem examination was made personally by Professor Haswell Wilson in my presence, and every effort was made to discover a primary

growth. Indeed, it had become almost a point of honour to do so, for Professor Wilson had maintained from the moment of seeing the first section that there must be a primary epithelial growth elsewhere.

There is a tendency for any experience which cuts diametrically across all our lines of thought to be ignored as inexplicable. The rash publisher of a case of primary carcinoma of bone is to the modern orthodox pathologist an infamous heretic, unworthy of credence. Nevertheless, inexplicable facts ought to be recorded, and I have taken the precaution of sheltering myself behind an eminent pathologist (to whom I wish to offer my thanks) in doing so.

UNUSUAL CASE OF TORN INTERNAL MENISCUS OF KNEE.

By F. LANGFORD, Bristol.

The following case well illustrates the great difficulty sometimes met with in finding an abnormal body in a knee-joint, even when it has been clearly demonstrated by X rays. It actually took two surgeons and four separate incisions to find the 'loose' body in this case, the abnormal structure being in itself unusual in that it was a densely calcified portion of internal meniscus still attached.

The patient, J. W. U., age 26, in 1919, while in the Army, fell into a trench and twisted his right knee, which became locked, painful, and swollen. He was treated, and the acute condition subsided in a few days. Ever since that time the knee has been liable to give way frequently, locking and becoming swollen. This came on about once a fortnight, not being caused by any definite movement. When locked, the joint could be freed by an outward blow on the inner side of the patella. The pain was always felt on the outer side of the joint.

In January, 1924, he entered hospital. Extension and flexion were slightly limited and painful, there was abnormal lateral mobility, and pressure on the outer side of the joint was painful.

First Operation.—On Jan. 28 the joint was opened by a curved incision on the outer side of the patella, and at the postero-external aspect of the joint a part of the external meniscus was found turned up; this was removed, as it was thought to be the cause of the trouble. The inner side of the joint was then opened by a similar incision, through which it was found that only a few tags remained of the internal meniscus, most of it having apparently disappeared. The wounds were then closed.

The patient states that during the two years since operation his condition has been much worse, the locking, swelling, and pain being more frequent and severe. He was admitted during one of these attacks, the effusion subsiding after a few days in bed. There was slight limitation of movements with abnormal lateral angulation due to laxity of the internal lateral ligament; nothing could be felt in or around the joint. X-ray appearances were exactly as in January, 1924, there appearing to be a loose body towards the back of the knee-joint on the inner side.

SECOND OPERATION.—(Mr. Hey Groves, Feb. 10, 1926.) The knee-joint was opened by a vertical cut through the patella and the tendon above and below, excellent access being obtained except to the posterior pouch on each side. Round its margins the articular cartilage was nodular and heaped up, suggesting an early osteo-arthritic change, and towards the back of the inner femoral condyle there was a definite pit in the cartilage, evidently resulting from continued pressure by some small body. The external meniscus showed that a portion had been removed, but was otherwise normal. Nothing was seen of an internal meniscus. In spite of prolonged search and manipulations, nothing was found sufficient to cause the pit in the femoral condyle. The anterior approach was then closed by a few catgut sutures through the divided tendon and ligamentum patellæ, and the inner and back part of the joint was opened by a short incision traversing the bursa between the semi-

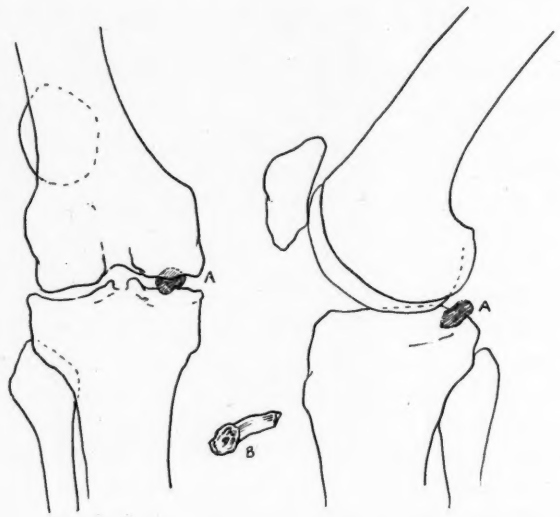

FIG. 118.—Diagram drawn from the X-ray appearances, showing anteroposteror and lateral views. A, Cartilage as shown in the skiagrams; B. Cartilage as removed ($\times \frac{2}{3}$).

membranosus and the inner head of the gastrocnemius. Inspection by this route disclosed a small bony-hard body, firmly tethered by a remnant of the internal meniscus, and probably representing the anterior horn turned back and calcified. This object shows clearly in the skiagrams as a bean-shaped shadow on the inner side of the joint (*Fig.* 118), and must have caused the pit in the articular cartilage of the femur. From its appearance, however, it might almost equally well have been the posterior horn, and the question which is so often discussed was once more brought to mind—can the posterior horn give trouble, more especially after the removal of the anterior horn as usually performed? If a posterior horn can give rise to a condition similar to that described above, some surgeons would consider it preferable to remove the whole cartilage.

It seems clear also from this case that there is still no one incision which will satisfactorily display the whole of such a complicated joint as the knee.

The crescentic incision on each side of the patella, and the patella-splitting approach, were all insufficient to discover the very definite body present in this knee. It would appear impossible to make sure of exploring the whole joint by using fewer than three incisions: one anterior, either the usual crescentic incision or the patella-splitting approach; and two posterior, one for each posterior pouch. These small posterior incisions are so easily made, and do so little harm to the joint, that their more frequent use in doubtful cases seems worth recommending.

The patient made a smooth and rapid recovery.

My thanks are due to Mr. E. W. Hey Groves for permission to publish this case.

INTESTINAL OBSTRUCTION IN AN INFANT 3 DAYS OLD, DUE TO ABNORMAL ROTATION OF THE MID-GUT.

By FRANK HARVEY, London.

Abnormal rotation of the mid-gut causing intestinal obstruction in a new-born child is a rare condition. It has been shown by Norman M. Dott, of Edinburgh,[1] that the clinical symptoms caused thereby occur most frequently within a few days of birth.

Embryology.—During the early weeks of embryonic life the liver and mid-gut loop grow so rapidly that there is insufficient accommodation in the abdominal cavity of the embryo, and as a consequence the mid-gut loop is situated in a funnel-shaped cavity formed by an extension of the cœlom—the umbilical cœlom—within the umbilical end of the cord.[2]

The superior mesenteric artery supplies the mid-gut loop and divides it into an anterior and a posterior segment. From the anterior or pre-arterial segment is developed all that part of the duodenum below the bile papilla, all the jejunum, and the ileum. From the post-arterial segment are developed the cæcum, appendix, ascending colon, hepatic flexure, and two-thirds of the transverse colon, the remaining third of the transverse colon being developed from the hind-gut.

At the tenth week the mid-gut loop returns into the abdominal cavity, and, according to Frazer and Robbins,[3] the pre-arterial precedes the post-arterial segments, as it is impossible, owing to their bulk, for both the segments to be reduced together.

As a consequence of this arrangement the hind-gut gets pushed to the left side of the abdominal cavity, and the small intestines occupy a plane posterior to the transverse colon with the cæcum and ascending colon on the right, as these are reduced last into the cœlom.

In the case to be described, the post-arterial segment apparently returned first into the abdominal cavity, so that the small intestines occupied an anterior plane to the large.

Description of Case.—On March 16, 1924, I saw, in consultation with Dr. T. D. Manning, of Sandhurst, Berks, a female child, 3 days old. The

child had passed nothing per anum since birth, and was vomiting dark-green fluid. On examination, the abdomen was very distended, especially so on the right side. The anus was small, and admitted a No. 10 Hegar dilator, which was passed for $\frac{3}{4}$ in., and on its withdrawal was not stained with meconium.

It was decided to operate immediately. An anæsthetic was administered, and, on opening the abdominal cavity by a right paramedian incision with

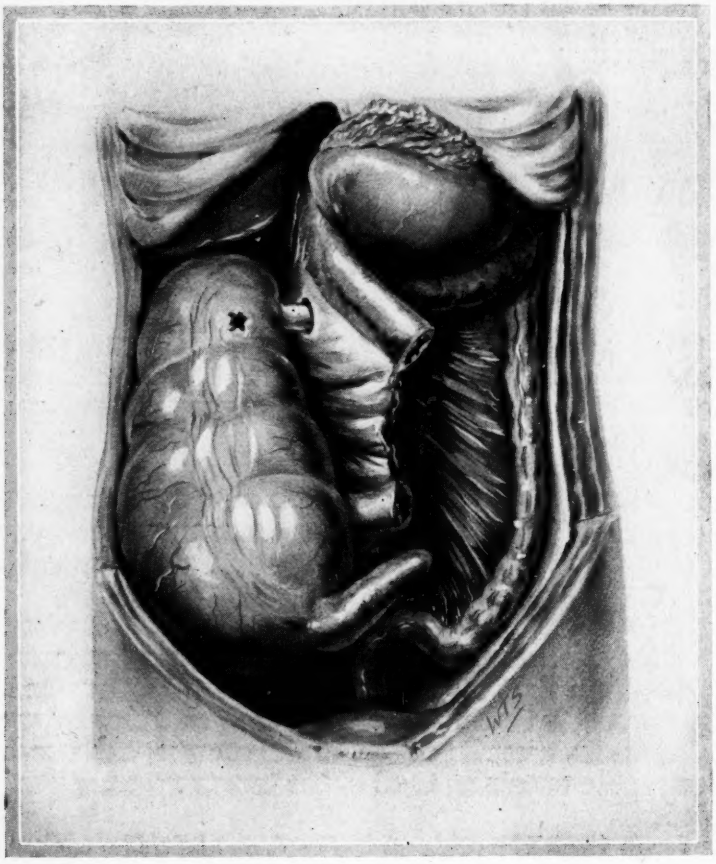

FIG. 119.—Semidiagrammatic drawing made from a sketch drawn immediately after the operation. The distended stomach with its rudimentary omentum is shown turned up on the costal margin to enable the position of the transverse colon on the posterior abdominal wall to be demonstrated. The hepatic flexure is shown displaced to the right so that the constriction of the transverse colon can be seen, where it passes through the mesentery of the small intestine. The opening in the mesentery was oval in shape and flattened in an antero-posterior direction.

its centre at the umbilicus, gas and fluid meconium gushed out, and coils of small intestine, distended with gas, presented. The cæcum was sought for and found just below the liver, not having completely descended into the right iliac fossa, and was greatly distended with gas, as was the appendix, which was blown out like the finger of a glove.

On tracing the ascending colon it was found to dip backwards towards

the vertebral column, and at the hepatic flexure was a rupture of all the coats of the bowel, from which meconium and gas were escaping. On further tracing the colon, it was seen to pass through a small opening about 5 mm. in diameter, in the mesentery of the small intestine, below the superior mesenteric artery. Further examination showed that the continuation of the colon, on the other side of the opening in the mesentery of the small intestine, was much reduced in size, being only about 5 or 6 mm. in diameter, as were the splenic flexure and the descending and pelvic colons.

Into the rupture of the colon was placed a drainage tube, and the opening closed around the tube by a purse-string suture of catgut, and the colon anchored to the anterior abdominal wall by a catgut suture. After sponging the abdominal cavity free from meconium, it was closed except for an opening through which the drainage tube passed.

The patient survived the operation but a short while. No post-mortem was granted.

CONCLUSIONS.

1. That adhesion and fixation of the mesentery occurs in the third month, and is probably completed by the fourth month, as otherwise the colon would not have been occluded in the case described above.

2. That according to Dr. A. Low meconium reaches the rectum at the fifth month, and that the obstruction in the case described must have occurred by the end of the fourth month.

3. That many unusual positions of the small and large bowel found during operations on adults are due to defective or abnormal rotation of the mid-gut at the third or fourth month of embryonic life.

In conclusion, I wish to acknowledge my indebtedness to Dr. T. D. Manning for providing me with the case for operation; to Sir James Berry for helpful criticism; to Sir Arthur Keith for kindly advice; to Mr. Ralph Coyte for his kindness in correcting the proofs; and to Mr. Thornton Shiells for his drawing of the case from a sketch made by myself immediately after the operation (*Fig.* 118).

Readers of the BRITISH JOURNAL OF SURGERY will remember that the whole subject of anomalies of intestinal rotation, with a most complete bibliography, bringing the subject up to date, was most admirably described and illustrated by Mr. Norman M. Dott in the Journal for October, 1923 (vol. xi). One of the illustrations represents a condition almost identical to that shown in the drawing of my case, which I may add was made before I had my attention drawn to this article. I wish to record my thanks to Mr. Dott for the invaluable help I derived from his paper in forming a correct interpretation of the condition found in the case I have described.

REFERENCES.

[1] DOTT, NORMAN M., *Brit. Jour. Surg.*, 1923, xi, 267.
[2] KEITH, Sir ARTHUR, *Human Embryology and Morphology*, 3rd. ed., 268 and 269.
[3] FRAZER, S. E., and ROBBINS, R. H., *Jour. of Anat.*, 1915, l, 75.

JEJUNOGASTRIC INTUSSUSCEPTION.

By HARRY DARLING, Sydney, N.S.W.

During the last two years three cases of jejunogastric intussusception following gastrojejunostomy have been recorded, and recently one such case came under my care at the Coast Hospital.

A male labourer, age 55, who had had gastrojejunostomy performed at another hospital five years previously for 'gastric ulcer', was admitted into the Coast Hospital suffering from 'intestinal obstruction'. Following an attack of diarrhœa (of eighteen hours' duration) he was suddenly seized, forty hours before admission, with severe cramping pains in the epigastrium, associated with vomiting, first of food and bile, and later of blood. The most severe pain came on in spasms, but it also had been continuous up to the time of his admission. The vomiting was frequent, and consisted of dark-coloured liquid blood with an extremely foul odour. The bowels had moved twenty-seven hours previously, but since then there had been inability to pass either flatus or fæces.

Examination.—The facial aspect denoted that the patient was extremely ill. His temperature was 97·6°, his pulse 120, and his respirations were 36. The extremities were cold, and the skin was clammy. The tongue was very dry and heavily coated, and the breath most offensive. The abdomen was neither distended nor rigid, but the respiratory movements were considerably restricted, and in the left hypochondrium was seen a swelling which appeared to be a dilated and distended stomach. This swelling was due to an extremely tender, indefinite, elongated mass, tympanitic to percussion, and about the size of a fist, which could be distinctly felt above and to the left of the umbilicus.

Operation.—The abdomen was opened and the stomach was found to contain a large sausage-shaped tumour. On turning up the colon the origin of an enormously distended jejunum was soon identified, running vertically upwards from the duodenojejunal flexure through a rent in the transverse mesocolon to the stoma in the stomach, to enable it to become continuous with the sausage-shaped mass in the viscus. Lying posterior to this short segment of distended bowel was found the collapsed efferent loop.

The intussusception was reduced with great difficulty by a combination of squeezing and traction, and it was then found that a posterior gastrojejunostomy had been performed, with a loop $2\frac{3}{4}$ feet long, and the proximal jejunal loop had intussuscepted for some $2\frac{1}{2}$ feet into the stomach through the gastrojejunostomy opening. The reduced gut was enormously distended, being three or four times its normal size, having its walls very œdematous, and showing areas of hæmorrhage. There was lack of pulsation in the vessels supplying the upper 4 in. of the loop. Owing to the man's shocked condition resection was out of the question, so entero-anastomosis was performed with a Murphy's button, 4 in. below the stoma. The patient grew worse in spite of stimulants, radiant heat, and saline infusion, and died seven and a half hours after the termination of the operation. The stoma in this case was situated on the posterior wall of the stomach, about $2\frac{1}{2}$ in. above the greater curvature, was horizontal in direction, and admitted two fingers.

REVIEWS AND NOTICES OF BOOKS.

Operative Cystoscopy. By E. Canny Ryall, F.R.C.S., Founder of and Senior Surgeon to All Saints' Hospital for Genito-urinary Diseases, London. Folio. Pp. 47, with 115 plates containing 670 original illustrations, of which 528 are coloured. 1925. London: Henry Kimpton. 70s. net.

This monumental work is the result of many years of labour by a surgeon who is an enthusiast in operative cystoscopy. After looking through it we feel a doubt as to which to admire more: the ingenuity of the author and his extraordinary industry or the beautiful illustrations by Mr. Thornton Shiells; between them they have produced a volume which is quite unique in English surgery.

The book consists of 47 pages of description by the author, and this is followed by 115 plates; the latter show cystoscopic pictures, X-ray appearances, opaque bougies, etc., and numerous instruments; some very well-drawn diagrams of the various intravesical procedures are also included.

In the preliminary letterpress the author describes his technique in detail, and lays great emphasis on the importance of the use of local anæsthesia; for this purpose he employs 4 fluid drachms of ½ per cent cocaine hydrochlorate; he claims that the injection of this into the urethra by his method has never produced any toxic symptoms, though it has been used in many thousands of cases, and that it is followed by good anæsthesia of the base of the bladder as well as of the whole urethra.

A large section is devoted to Ryall's own treatment of calculus impacted in the ureter; to entice the stone from the ureter into the bladder, he makes use of a large number of devices: the passage of special conical bougies, of expanding dilators, and of laminaria tents, dividing the ureteral orifice with scissors or with a diathermy blade. In almost every case the instruments employed have been invented by the author; one of the most attractive of these is a small ureteral lamp which he passes to assist the finding of the ureter when it is cut down on in the ordinary way. If we were to make a criticism, it would be that both the operator and the patient must have been very long-suffering, as, in some of these cases, the treatment extended over many weeks and necessitated a great many cystoscopies. In one exciting case, in which a double ureterocele was treated by diathermy, a partial anuria followed, and was cured by plunging a cystoscopic knife into a distended cyst.

The author's treatment of stone in the bladder is equally striking; he crushes them with his special cystoscopic lithotrite, and claims that it is a great advantage to be able to see what is actually happening; this is specially so if the calculus is in a sacculus; even his method of evacuation of the fragment is original, for he uses a cystoscopic evacuator by which he can see the position of the fragments and whether any have been left behind. His technique for the removal of foreign bodies from the bladder is most ingenious and well illustrated.

There are some excellent plates showing the method of treating bladder growths by diathermy; the author has again invented his own instruments; perhaps the most striking point is the really extraordinary absence of scarring after this operation. A good deal of stress is laid on the importance of extreme care in the employment of diathermy on those parts of the bladder which are covered by peritoneum.

The last section deals with those various conditions of the prostate which are amenable to intravesical treatment. Certainly the most fascinating and original part of the book, and possibly the most valuable, is that which concerns the diagnosis and treatment of the numerous conditions which may lead to a persistent suprapubic fistula after prostatectomy; they are very various, and Ryall's way of dealing with them is highly ingenious and effective.

It would seem an ungrateful task to point out some defects in such an excellent work; and if we do so, it is with the hope that the author will see his way to have them corrected in future editions. Some of them are obviously printer's errata; thus on page 2, *Plate VIII, Fig.* 1, should be *Plate I, Fig.* 1; later in the book, the text explaining *Plate XCI* appears opposite *Plate XC* and the text of *Plate XCII* is opposite *Plate LXXXIX*. On page 16, for "a contracted and irritant bladder" we should surely read "a contracted and irritable bladder."

The descriptions of the plates are all given in English, French, and German; it is an astonishing fact that the author, so indefatigable and meticulous in his cystoscopic work, should have allowed so many mistakes to creep into the French translation; accents, genders, grammar, all are wrong. Macaulay's famous student could have detected hundreds of errors; to give an example, the "dragged-in appearance of the right orifice" is translated as "l'aspect dragué de l'orifice droit"; the French have certainly adopted some English words which look very queer, for instance the use of the word 'stopper' in the sense of stopping a steam boat, but we think they have not yet incorporated the word 'drag'—at any rate, in that sense. We apologize to Mr. Canny Ryall for these few captious remarks, but we think that such very crude French might produce an unfortunate impression on the other side of the channel.

We sincerely congratulate the author and the artist on their *opus magnum*, and we hope that the former will long continue to work at this subject and produce new instruments and show us how to use them; indeed, we look forward with confidence to the time when he will produce a ureteral lamp which will show us a papilloma or an angioma of the kidney pelvis, and also a method of arresting the bleeding from such a source without the deplorable necessity of bisecting an otherwise healthy kidney, with the inevitable result of a gross diminution of its functional capacity, and, frequently, its later removal for secondary hæmorrhage.

La Curiethérapie des Cancers. By SIMONE LABORDE, Chef au Laboratoire de Radiologie au Centre anticancéreux de Villejuif. Medium 8vo. Pp. 334, with 43 illustrations. 1925. Paris: Masson et Cie. Fr. 27.

THE progress made in radium therapy is admirably discussed in this book of Dr. Laborde. The author follows the development of technique from the earlier days, when treatment was more or less empirical, to the present, when in spite of gaps in our knowledge the sure foundation of scientific accuracy is slowly being reached.

One cannot but be impressed by the masterly summary of data given in the preface. In this short section a comparison is made between the action of X rays and radium, and attention is drawn to the fundamental difference between the technique of these two agents. In radium therapy it is suggested that, if a continuous action by the radiations over a long time period is used, the effect on the growth and the normal tissues is likely to be more beneficial; this is in accordance with modern views, and is substantiated by experimental work on all growths in vivo and in vitro. The action of X rays is contrasted in so far as it must necessarily be intermittent; if used continuously the duration of the exposure is necessarily much shorter than when radium is employed.

The important point is also made that the destructive action on the blood-cells and other normal tissues is much less when radium is used than it is with X rays. The important question of how much of the effect may be due to the indirect actions of the rays is, however, only tentatively suggested, and it has yet to be proved that radium in this respect is equal to X rays, which by virtue of the greater certainty and the wider distribution of the rays may exercise a more decided action in the direction of indirect effects. The important indications given by the results of recent work with radium rather favour the use of X rays in a manner similar as nearly as possible to the radium technique.

A brief section indicates that the probability of using both agents has not been overlooked. The importance of the biological reaction is made clear, and the author wisely makes the following statement: "Thus it is possible that our ideas relating

to the action of rays on cancers, an action attributed at present solely to a local effect, will one day be changed." In fact that conclusion has already been reached by a number of observers, and much research is now being directed to the elucidation of the indirect effects of radiations upon the tissues as a whole. The fact is apparent that both actions contribute to the general effect.

The important question of minimization is also given due prominence throughout this work. It is pleasing at the end of this excellent summary to see a reference to the permanancy of the work of Dominici, one of the earliest workers, and to the far-sighted view he took, in those early days, of the action of radiations upon tissues.

A notable part of the work deals with 'units', and a record of the development of the unit is given. In the beginning of radium therapy the method was haphazard, largely because of the instability of the applicators; the physical laws were understood from the beginning, but the preparation and scaling of the applicators left much to be desired, while impurities in the compounds of radium also contributed to inaccuracy. The unit of radium is the gramme of radium element, but as this represents a large quantity it is more convenient to use the milligramme of radium element present in any applicator as the unit. The unit of emanation is the curie —that is, the quantity of emanation in equilibrium with one gramme of radium element; as this is also relatively a large quantity, it has become customary to refer to the millicurie as the standard of the emanation.

The clinical forms of cancer are described, and the diagnosis is entered into fully. The types of carcinoma are compared as regards malignancy. Regarding biopsy, or the removal of a small piece of a growth for pathological examination, reference is made to its importance in establishing an accurate diagnosis. The need for expert manipulation in special regions is emphasized. The author evidently does not share the fear so often expressed by some workers of opening up channels of dissemination by this procedure. The value of radiography as a diagnostic aid is also alluded to, and attention is called to the difficulty of interpretation of radiographic plates. Modern methods of radiographic technique, such as inflation of the ventricles of the brain in the localization of cerebral tumours, are appreciated.

A brief reference is made to the blood changes in cancer. These are marked, but up to the present the author does not think that there are any changes which are specific. Chemical changes, on the contrary, appear to be more constant; glucose is often found in excess, and a diminution in the total albumins is observed. These, however, though interesting from the biological side in cancer, do not carry with them any diagnostic points of practical interest.

An important matter is discussed under the heading 'latent period'. This has reference to the action of radiations generally, and is of great value in practical work. The length of this period depends upon the nature of the ray, the dose employed, and the organism irradiated, and also on certain biological factors, among which the cell activity holds a notable place.

A careful consideration is given to the technique of radium therapy; this is described fully in regard to radium salts and emanation, while the actual measurement of the rays is dealt with in a scientific way. The method of application is also handled from the essentially practical point of view.

The remaining chapters of the book are devoted to a regional consideration of the various forms of malignant disease; these sections are abundantly illustrated by half-tone blocks showing cases before and after treatment. A number of striking cases are shown, which go to prove that radium in the hands of an expert is capable of causing the disappearance of a number of obviously malignant tumours.

The book details a careful and scientific survey of the radium therapy of malignant tumours. It is the work of a most thorough and careful investigator, who from the beginning to the end shows a mastery of the subject combined with a moderation of view which is commendable. It is obviously considered from the standpoint of a scientist who is at the same time a physician familiar with the clinical aspects of the disease with which he has to deal. Readers will find within the pages of this work much that is useful, and as a whole it can be relied upon to give precise information on a large number of difficult points in practice. The author in her

preface states that the object of the book is to answer the numerous questions asking for a definition of the indications for radium therapy and a description of the technique. She has succeeded admirably in giving just the information required by those not conversant with the matter, and she is to be congratulated on the excellent manner in which she has completed her task.

The Royal College of Surgeons of Edinburgh: Historical Notes from 1505 to 1905. By CLARENDON HYDE CRESWELL, F.S.A. (Scot.), late Officer and Sub-Librarian of the College. 8vo. Pp. 315 + xv, illustrated. Privately printed for the College by Oliver & Boyd, Edinburgh, Tweeddale Court; London, 33, Paternoster Row. 10s. net.

MR. C. H. CRESWELL was Officer and Sub-Librarian of the Royal College of Surgeons of Edinburgh from 1899 until 1918. He died on active service, leaving the materials from which the present volume is compiled. The President's Council, in whose hands the manuscript was left, have done well in causing it to be edited and published, though the names of those responsible for seeing it through the press are only indicated by initials. The volume is wisely entitled *Historical Notes* rather than a history of the College. It provides the *Quellen* from which a future historian will draw much of his material, elaborating what is here set down, collating it with what is known of the sister Colleges, and amplifying it with a variety of interesting details.

The development of the Edinburgh and English Colleges of Surgeons has proceeded along somewhat similar lines. The first notice of the Edinburgh College is in 1504, when it appears as a guild with an altar dedicated to St. Bride in the Kirk of St. Giles. The patron saint of the craft was St. Mungo, and Master David Lauder was the Chaplain. The future historian will have to work out the earlier history from 1210 to 1505. The religious guild was already a trade guild, and, like the other trade guilds in Edinburgh, was dominated by the Town Council, in whose election the surgeons had no vote. Being barber surgeons, they were tradesmen, and as tradesmen they had a monopoly for the making and selling of aqua vitæ. There is some evidence of a few of the members of the guild acting solely as surgeons. The future historian will have to differentiate these men and discover the exact position they held. It is probable that they were like the sworn surgeons or the town surgeons of the free cities in Germany. In process of time—that is to say, about 1657—the trades of barber and surgeon gradually drifted apart without any formal separation such as happened in England in 1745. The barbers remained as barbers, the surgeons allied themselves to the apothecaries and became surgeon apothecaries. The compound title was dropped and the surgeon apothecaries became surgeons. The Incorporation of Surgeons was called a College in 1686 and became The Royal College of Surgeons of the City of Edinburgh in 1778.

The book is well printed and the eight illustrations are well reproduced. The Latin on pages 163 and 194 is such as would "break old Priscian's head". It should be made congruous in the next edition.

Traumatic Injuries of the Carpus, including Colles's Fracture. By KELLOGG SPEED, S.B., M.D., F.A.C.S., Assistant Professor of Clinical Surgery, Rush Medical College of the University of Chicago, etc. Imperial 8vo. Pp. 197 + xvi, illustrated. 1925. London: D. Appleton & Co. 21s. net.

THIS is an admirable book. The English reader is liable at first to be put off by the transatlantic phraseology and the use of the new anatomical nomenclature, which in the case of the wrist-joint differs very greatly from the old. When, however, these little difficulties have been mastered, we find that there is here a very thorough and extensive monograph on wrist injuries of all sorts.

The first chapters are given up to Colles's fracture and its varieties. Perhaps the most important statement found here is: "Practically all of the Colles's fractures which lead to permanent disability have resulted from improper reduction, coupled with one other important factor which seems to be a common error among practitioners—prolonged splinting." An excellent description of methods of reduction is given, and a very careful consideration of the criteria of proper replacements. The section on operative procedures is not so good. The details of this very difficult

exposure are omitted, and no mention is made of whether a wedge should be removed or a curved osteotomy carried out. Two statements which may be doubted are that in separation of the epiphysis the bone gives way through the cartilage (it is generally considered to give way on the diaphysial side of the cartilage), and that in a chauffeur's fracture the fragments are almost never comminuted (the general experience would seem to be that comminution is more frequent in a severe chauffeur's fracture than in a true Colles's fracture).

The second part of the book deals with injuries of the carpal bones in very great detail. A nomenclature is devised which is complicated, but at the same time, when once mastered, does give a true description of the anatomical lesion present. Thus a fracture of the navicular with dorsal dislocation of the second row of the carpus together with the distal half of the navicular and the triangular is named a 'trans-navicular-perilunar dorsal dislocation of the wrist'. The mechanism of production of all the carpal injuries is considered in detail, and there are ample illustrations by X-ray photographs and diagrams which will assist in unravelling the complexity of many of these injuries. The pathological changes occurring in damaged carpal bones are also described, as well as the methods of approach for operative procedures when removal of some of the bones is necessary.

One point which might receive further attention is the prognosis of these carpal injuries, particularly after the removal of individual bones or portions of bones. The statement is made that the writer has removed 20 lunates, 6 combinations of lunate and navicular, and 11 naviculars after fracture, and all with satisfactory functional return. A little more detail as to the time taken to get this restoration of function and the actual range of mobility remaining in the wrist would be of great assistance to those who meet with comparatively few cases of carpal injury and desire guidance as to the advisability of operative procedures on individual cases.

The Treatment of Fractures and Dislocations in General Practice. By C. MAX PAGE, D.S.O., M.S., Senior Surgeon to Out-patients, St. Thomas's Hospital, etc.; and W. ROWLEY BRISTOW, M.B., B.S., F.R.C.S., Surgeon to the Orthopædic Department, St. Thomas's Hospital. Second edition. Demy 8vo. Pp. 279 + xiii, illustrated. 1925. London: Humphrey Milford. 12s. 6d. net.

THE authors have certainly enhanced the utility of the new edition by including some common dislocations, but this has perhaps made more obvious a want of balance in the book to which we referred in our former review. Fractures of the skull and mandible can scarcely be of less importance to general practitioners than those of the arm; yet the space accorded to the former is little more than that devoted to fractures round the wrist, and the treatment of intracranial hæmorrhage is unworthy of a manual for first aid.

We do not consider that the chapter on operative treatment is up to date; it is not our experience that "the plate is liable to loosen after two or three months" *unless it has been ejected at the operation*; and the figure showing the screws pulling out and the plate loose depicts a condition which must surely be of extreme rarity in any clinic where reasonable cleanliness is observed.

The figure of a fractured humerus treated with the elbow extended in a Thomas should be replaced, for even though it is borrowed from a high orthopædic authority it lays stress on a position which should only be permitted when good alinement can be obtained in that position only.

We would like to see greater stress laid on the value of immediate X rays in two planes after reduction of fractures; this particularly applies to Pott's fracture, but nothing is said in this connection. Surely Mr. Page does not confine his operations for Pott's fracture to those in which vicious union has occurred; if so it is not surprising that he has not a high regard for operative treatment. This is personal and unimportant in comparison with the author's failure to seize a grand opportunity of impressing on the practitioner that the best way to treat mal-union is to prevent it.

There is much that is sound and useful in this book, and we have often referred to it for guidance; it could be improved if the authors would write more fully on common conditions of which they have experience rather than include many rare injuries which they do not happen to have come across.

Die Chirurgie: A System of Surgery. Edited by Professor KIRSCHNER (Königsberg), and Professor O. NORDMANN (Berlin). To be completed in six volumes. Imperial 8vo. 1926. Berlin: Urban & Schwarzenberg. Fasc. 6, Vol. IV, pp. 358, with 107 illustrations in the text and 23 coloured plates, M. 21; Fasc. 7, Vol. I, pp. 277, with 288 illustrations in the text and 7 coloured plates. M. 17.

FASCICULUS 6 deals with the surgery of the mouth and that of the larynx and trachea. The former part is by Professor Brüning (Berlin). It gives a very complete account of the diseases of this region, including rare affections, e.g., trichinosis and leprosy, as well as the common condition of malignant disease. The older classical operations for the latter are well described and illustrated, but the details of lymphatic extirpation are very meagre, and block-dissection is not mentioned. Also the prognosis after operations for epithelioma of the tongue is not discussed, and various operations of removal of the floor of the mouth with a part of the lower jaw are described without any warning that such operations seldom prolong life sufficiently to make them worth while. The chapters dealing with the salivary glands are very good and clear, the diagrams showing the deep relations of the parotid being very useful.

The section on the larynx and trachea is by Professor Soerensen (Berlin). It is generously illustrated both in black and white and in colour. The fine series of coloured drawings showing extirpation of the larynx are very realistic, but from an artistic point of view are decidedly crude. A useful and detailed account of the methods of local anæsthesia as applied to neck operations is given.

The first part of Fasciculus 7 is by Dr. Gohrbandt, and consists in an excellent description of the art of surgical sewing, with a great number of clear diagrams giving knots and stitches of every kind, and special methods of joining or mending blood-vessels or viscera. There follow two sections on pyogenic and specific infections, by Dr. Buzello and by Professor Eden with Dr. Drevermann respectively. The chapter on pyogenic infection is well arranged, and illustrated with typical bacteriological and clinical figures, including coloured figures of cases of gas gangrene.

Cancer of the Rectum. By W. ERNEST MILES, F.R.C.S., Senior Surgeon to the Cancer Hospital, etc. Demy 8vo. Pp. 72 + viii, illustrated. 1926. London: Harrison & Sons Ltd. 7s. 6d. net.

THIS little volume contains the Lettsomian Lectures delivered before the Medical Society of London in 1923. The text of the lectures has not been altered, nor have any additions been made to it. The views of Mr. Miles upon cancer of the rectum are now well known. They are based upon two fundamental conceptions: (1) That a knowledge of the pathological state and tendencies of a malignant growth should be known, and these include a clear understanding of the anatomy of the lymphatic system of the parts involved; (2) That the widest possible operation, based upon that knowledge, should be performed on all cases unless the contrary indications outweigh this necessity. These two conceptions are studied with the utmost care, and an experience unsurpassed in this country is brought to bear upon their elucidation. The operation practised by Mr. Miles is fully described and well illustrated.

We do not need to examine in detail the wealth of material compressed in this small volume. It is the best exposition of the subject with which we are acquainted. If observation and a logical deduction from the facts gleaned by careful investigation are to decide the question of the operation to be practised in this grave disease, the methods of Mr. Miles must receive our favourable verdict. Unhappily the reticence of cancer of the rectum in many cases, the very late stage of the disease found when the patient is first examined, and the cachexia which has had time to develop, stand often in the way of our ideals. But Mr. Miles's work is steadily helping us all to a better realization of the possibilities of surgery even in advanced cases. We consider that Mr. Miles has done much for the credit of British surgery, not only by his careful and long-continued observations, but by the perfecting of an operation which in his hands is a model of design and exquisite accomplishment.

The Diagnosis, Treatment, and End-results of Tuberculous Disease of the Hip-joint. By GEORGE PERKINS, M.Ch. Oxon., F.R.C.S., Assistant Surgeon to the Royal National Orthopædic Hospital, etc. Demy 8vo. Pp. 118 + x, with 32 illustrations. 1926. London: Humphrey Milford. 6s. net.

THIS small book is the first monograph for which the 'Robert Jones' prize and medal has been given. It represents a clear account of certain phases of hip disease and certain methods of treatment, but is too brief to be of great value. The author strongly advocates the advantages of a special form of fixation frame; he lays great stress on traction in the treatment of the disease; and he considers that active operative methods may have some place both in the treatment of tuberculous abcesses and of early stages in the diseased joint. The most valuable part of the book is a description of the late results of treatment in fifty cases which have been followed up for some years. The X-ray illustrations are very clear and add great value to the text.

Contribution à l'Etude des Paraplégies Pottiques. By Mme. le Docteur SORREL-DEJERINE, ancien Interne des Hôpitaux de Paris. Royal 8vo. Pp. 402, with 97 illustrations. 1926. Paris: Masson et Cie. Fr. 40.

THE author of this volume is Madame Sorrel-Dejerine, wife of Dr. E. Sorrel, Director of the Hôpital Maritime de Berck, and daughter of the late Professor Dejerine; there is an introductory preface by Dr. André-Thomas. The expectations aroused by work with such an ancestry are amply fulfilled. The first 230 pages are devoted to a study of 44 cases of Pott's disease with paraplegia, and the clinical details of these cases are fully described in the second part of the book. There are, in addition, eight pages of references, giving a full and very useful bibliography.

An interesting historical survey of the subject is followed by chapters discussing the mechanism of compression and the morbid anatomy both of the spinal column and of the cord. The study of the changes found in the cerebrospinal fluid is of special interest. Eighteen cases were examined by the lipiodol method of Sicard, and as a result of this the writer claims to be able to distinguish between cases in which the compression is due to abscess and those in which it is due to pachymeningitis. In some of the cured cases the lipiodol was still held up after a long interval, and this she attributes, not to adhesions as one would expect, but to the actual deformity of the spinal canal, since a similar blockage is found in some cases of severe deformity in which no cord symptoms have ever occurred.

With regard to treatment, Madame Sorrel-Dejerine insists that complete fixation in a recumbent position is essential, and unhesitatingly condemns the 'ambulatory' treatment with spinal jackets. Operative treatment is also condemned as unnecessary and ineffective, and indeed her experience in these 44 cases is so good as amply to justify the attitude which she adopts in this respect.

Among 35 of the cases treated at Berck and followed to a termination, 24 were completely cured in from eighteen months to two years, whilst in 8 the symptoms remained stationary, and 3 patients died. It is somewhat surprising to note that the writer finds no difference in prognosis between adults and children, and believes that age is not a factor of importance, a conclusion which is not in accordance with the usual experience in England.

Gynecologic Urology. By LYNN LYLE FULKERSON, A.B., M.D., F.A.C.S., Assistant Professor of Gynæcology, New York Post-Graduate Medical School, etc. Royal 8vo. Pp. 247 + xiv, with 166 illustrations, including 86 original and 14 colour plates. 1925. London: William Heinemann (Medical Books) Ltd. 27s. 6d. net.

THE author states, in his preface, that "this book is devoted to the technique of endoscopy and cystoscopy in the female, and the diagnosis and treatment of the commoner diseases of the urological tract. The technique for the most usual operations on the kidneys, ureters, bladder, and urethra is given. While many works on male genito-urinary diseases have been written, there is no small volume that presents the essentials of gynecologic urology in a form that should enable students to quickly acquire a working knowledge of the subject."

We cannot express any great enthusiasm for this book. To begin with the preface, we think it is open to argument whether it is desirable that students should *quickly* acquire a working knowledge of such a subject; however, for the sake of those students who like their knowledge in tabloid form, we may say that there is a great deal of information contained in this book of 227 pages, about one-third of which are taken up by the illustrations.

Unfortunately the information has not, we think, been thoroughly digested, and there are many inaccuracies. To give some examples: it is stated that with polycystic kidney the urine is negative unless hæmaturia is present; from our own experience we should have stated that the urine is invariably of low specific gravity and contains a trace of albumin. Again, in a very short sketch of the embryology of the kidney and ureter, the author states that the ureter develops from the so-called pronephros, the kidney from the mesonephros.

When reading American books, the average English surgeon expects some curious spelling, but the author's spelling of 'stranguary' is surely very unusual; some may mercifully be imputed to the printer, such as the 'vestibulum pundendi' and 'longitudinal folbs', also a 'stereopticon roentenogram'.

The illustrations which have been borrowed from Kelly and Judd are beautifully reproduced, but the original ones are poor and difficult to decipher.

We consider that the idea of writing a book on urology which will appeal particularly to the gynæcologist is quite a sound one, but we suggest that the author wrote it hurriedly; how else can one explain his laying himself open to the mocking remarks of the flippant when he states that for the sterilization of catheters 'a sterile nurse' should be provided?

Thérapeutique chirurgicale. By P. Lecène (Paris) and R. Leriche (Strasbourg). Vol. III (Abdomen et Organes génito-urinaires). Vols. I and II in the press. Royal 8vo. Pp. 646. 1926. Paris: Masson et Cie. Unbound, Fr. 50; bound, Fr. 60.

"We believe," say the authors, "that there exist certain therapeutic principles, that is to say, rules of practice based on experience, which have a general application in a group of individual cases of which it is of value to set out the significance and the importance."

Surgery is composed of three essential parts: (1) The indications for surgical treatment; (2) The realization of these indications; and (3) The results of the surgical act.

In this book the authors touch but lightly on surgical technique, but pay much attention to the indications for surgery from the standpoint of both the physician and surgeon, and make a critical study of the results, both the immediate and the end-results. In other words, the object of the book is to discuss and ascertain the true curative value of surgical intervention. This, though very laudable, is an ambitious objective, and in our opinion it has been carried out with a considerable measure of success, which should be improved on in later editions. It appears to be the honest opinion of two surgeons of great ability and tried experience, and we compliment them on their endeavour.

A Descriptive Atlas of Visceral Radiograms. By A. P. Bertwistle, M.B., Ch.B., F.R.C.S. Ed.; and E. W. H. Shenton, M.R.C.S., L.R.C.P., late Senior Surgical Radiographer, Guy's Hospital. 4to. Pp. 250 + xx, with 330 illustrations. 1926. London: Henry Kimpton. 21s. net.

This volume should prove useful to the busy general practitioner who wants to bring his knowledge up to date in the subjects dealt with. We think for students the detailed explanatory notes are not full enough, and cannot compare with a text-book such as that by Knox. The radiographs are excellently reproduced and are a credit to the publishers. It might perhaps have been better to thank each contributor of the radiographs in the preface only, and not to have placed the name of the radiographer under each individual radiograph.

Thoracic Surgery. The Surgical Treatment of Thoracic Diseases. By HOWARD LILIENTHAL, M.D., F.A.C.S., Consulting Surgeon to Mount Sinai and Bellevue Hospitals; Professor of Clinical Surgery, Cornell University Medical College, etc. Two volumes. Royal 8vo. 1925. Pp. 1294 (with 904 illustrations, 13 in colours). Philadelphia and London: W. B. Saunders Co. 90s. net per set.

THIS is a publication of first importance, and may be described as the greatest existing work on thoracic surgery in the English language. Its only rival is Sauerbruch's monumental work *Chirurgie der Brustorgane*, the second volume of which was issued last year. Lilienthal's book does not quite equal this work in size, minuteness of detail, or in illustrations, but it has the great advantage for the English-speaking people that it is easily understood.

The subject presented is treated in a very comprehensive manner, starting with the physiology and anatomy of the chest and its viscera, and then passing on to a study of diseases and injuries of special parts. The book is well printed in good type; the illustrations are good and easily understood, and we can confidently recommend the work to anyone interested in thoracic surgery.

Allgemeine und spezielle Chirurgie des Kopfes, einschliesslich Operationslehre. By EDUARD BORCHERS, Professor of Surgery, University of Tübingen. Royal 8vo. Pp. 382, with 326 illustrations. 1926. Berlin: Julius Springer. 54 Reichsmarks.

THE plan of this book is to give an account of the surgery of the head—not only of the brain, but of all the structures entering into the formation of the head. It is therefore a text-book of the general and special surgery of the most important affections of the head, considered on an anatomical rather than a pathological classification.

The book is divided into two parts. The first part consists of six chapters, dealing with: (1) Congenital defects; (2) Injuries; (3) Inflammations; (4) Tumours; (5) Diseases of the temporomaxillary joint; (6) Diseases of the facial nerves. The second part is divided into four chapters as follows: (1) General anæsthesia; (2) Local analgesia; (3) Asepsis; (4) Typical operations. The letterpress is very good, with clear accounts of the various clinical conditions, and the whole is profusely illustrated with excellent pictures, many of which are coloured.

It does not appear to us that the volume will be of great use to English practitioners, because, however good otherwise, it is an uneconomical proposition to need a separate book for each region of the body.

Collected Papers of the Mayo Clinic and the Mayo Foundation. Edited by Mrs. M. H. MELLISH. Vol. XVI, 1924. Royal 8vo. Pp. 1331 + xix, illustrated. 1925. London and Philadelphia: W. B. Saunders Co. 60s. net.

REALIZING that this would be at least his tenth endeavour to preach briefly on surgery with the Mayo Papers as his text, the reviewer could not fail to notice marked changes which have been brought about in these volumes. There are still weighty clinical papers which every surgeon must digest, such as that in this volume by Jean Verbrugge on gastrojejunocolic fistulæ; but they now are in a large minority, and it is no disparagement to their importance to rate them less highly than those on general scientific subjects such as that by Dr. C. Mayo on calcium, or those on experimental physiology by Mann and others on the functions of the liver and gall-bladder; these latter contain much which every surgeon responsible for the teaching of an advanced class must be able to put before them in a digested form. It appears, therefore, that whereas the earlier volumes were to the young surgeon a text-book which he must almost know from cover to cover, the *Mayo Papers* have rather come to take the rôle of a book of reference in which one can scarcely fail to find something instructive on almost any subject allied to surgery; a book to which, when in doubt as to the relative value of two different abdominal operations or some pathological problem, no teacher can apply without some ray of most valuable information.

Studies in Intracranial Physiology and Surgery. By HARVEY CUSHING, M.D. Royal 8vo. Pp. 146 + xii, illustrated. 1926. London: Humphrey Milford. Paper, 8s. 6d. net; cloth, 10s. 6d. net.

THIS volume contains the three Cameron Prize Lectures delivered at the University of Edinburgh in October, 1925. They deal with the circulation of the cerebro-spinal fluid, the pituitary gland, and intracranial tumours, and are based upon work carried out by Harvey Cushing and his colleagues over a large number of years. Embodying as they do not only the results of experimental work and clinical observation, but also the ripe experience of the lecturer, they form a contribution of the utmost value to the surgery of the nervous system. The book exhibits 'team work' at its best, and is presented in the concise and graphic manner which characterizes the writings of Harvey Cushing.

Perhaps the most interesting section is that which deals with the gliomata. The work of Percival Bailey suggests that the well-known differences in the clinical behaviour of these tumours may come to be correlated with characteristic histological differences, and the results of his painstaking investigations go far to indicate the lines which such correlation may eventually be found to follow.

An Introduction to Surgery. By RUTHERFORD MORISON, M.D., F.R.C.S. Ed., F.R.C.S. Eng., Emeritus Professor of Surgery, Durham University, and CHARLES F. M. SAINT, C.B.E., M.D., M.S., F.R.C.S. Eng., Professor of Surgery, Capetown University, S. Africa. Second edition. Demy 8vo. Pp. 347 + vii, with 183 illustrations. 1926. Bristol: John Wright & Sons Ltd. 15s. net.

THE hardest thing in the world to do is to write a good introduction to surgery. Therefore, though there are many things that might be said against the arrangement and way in which the details have been carried out, great credit should be given to the authors for attempting to set out general principles, and to encourage students to observe and think for themselves.

Manual of Emergencies: Medical, Surgical, and Obstetric. By J. SNOWMAN, M.D., M.R.C.P. Crown 8vo. Pp. 361 + viii. 1926. London: John Bale, Sons, & Danielsson, Ltd. 10s. net.

THIS is a small pocket-book, well printed on thin paper and including a reference to all emergencies. Actually the surgical section only represents about eighty pages, and the information is so much condensed that we should not have thought it would be of much practical value; but accuracy and simplicity appear to be present, and will no doubt do much to recommend the book.

Guy's Hospital Reports. Edited by ARTHUR F. HURST, M.D. Vol. LXXVI (Vol. VI, Fourth Series), No. 1, January, 1926. Royal 8vo. Pp. 126, illustrated. London: Wakley & Son (1912) Ltd. 12s. 6d.

Guy's Hospital Reports continue to issue a variety of interesting articles, but in this number most of the papers are of medical rather than surgical interest.